

Mr. Patrick Quinn Missouri Department of Natural Resources Hazardous Waste Program 1738 East Elm Street Jefferson City, Missouri 63101

Comments concerning the Enhanced Bioremediation Pilot Test Report for RE: the McDonnell Douglas Tract I Facility, Hazelwood, Missouri, Permit # MOD000818963

Encl: Revised Enhanced Bioremediation Pilot Test Report for McDonnell Douglas Tract I, Hazelwood, Missouri

Dear Mr. Quinn;

Following is our response to your April 21, 2004 comment letter on the Enhanced Bioremediation Pilot Test Report for the McDonnell Douglas Tract I Facility.

# Specific Comment 1.

As discussed during our March 19, 2004 meeting, the reference to two pounds per foot is a typographical error. Six pounds per foot of HRC was used in each boring, for a total of 810 pounds in the nine borings. The report text has been corrected.

# Specific Comment 2.

The amount of water released by the fire line, which is owned by GKN, is not known. An increase in dissolved oxygen was noted in the pilot test wells immediately following the release and at the subsequent sampling, 30 days after the release. The dissolved oxygen levels returned to the favorably low levels in the sampling conducted 60 days after the break. It is possible that this increase in dissolved oxygen my have temporarily slowed the rate of reductive dechlorination; however, it did not appear to have any longterm effect on the pilot test. A discussion of this has been added to the conclusions of the report.

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107E-5556-JWH 6 May 2004

# Specific Comment 3.

DCE concentrations in MW-3 were reduced by 21 percent at the end of the pilot test and by 95 percent in MW-3B. DCE created by the dechlorination of TCE will be exactly the same as the DCE present in the groundwater before the start of the pilot test and would not be preferentially degraded. In fact, the cis-DCE present before the start of the pilot test was almost certainly the result of natural dechlorination of TCE, since cis-DCE is not a constituent commonly found in commercial or industrial products and is not known to have been used at the facility. Vinyl chloride concentrations increased for the first half of the pilot test and then were observed to decline. Based on the data collected, the decline in vinyl chloride concentrations is expected to continue.

The data clearly indicate that dechlorination of all chlorinated compounds, including DCE and vinyl chloride, occurred (for example, detection of ethane/ethane at the same time vinyl chloride concentrations declined). The report clearly presented this data, for example, clear trends for reduction of DCE and vinyl chloride can be observed in Figure 5-1. The conclusion section of the report has been expanded to emphasis these findings. Because of the sequential process of reductive chlorination, DCE and vinyl chloride will be reduced later than and typically at a slower rate than PCE or TCE.

The report was not a Risk Assessment or Corrective Action Plan, therefore, evaluation of risk and discussion of long term monitoring, etc. is not part of the report scope. Since a Risk Assessment has already evaluated the area and concluded that there is no risk, the timeframe for degradation to the risk-based threshold has occurred, but this is what would be discussed in the Corrective Measures Study, not in the report of pilot test findings.

Please contact me if you have any questions.

Sincerely,

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C: Ms. Demetra Salisbury, United States Environmental Protection Agency Region VII

# Enhanced Bioremediation Pilot Test Report for McDonnell Douglass, Hazelwood, Missouri

Prepared for:
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April 2, 2004



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#### List of Abbreviations and Acronyms

below ground surface bgs Boeing **Boeing Company** °C degrees Celsius ٥F degrees Fahrenheit **DCA** dichloroethane DCE dichloroethene DO dissolved oxygen dissolved organic carbon DOC Boeing Tract 1 facility **Facility HRC** Hydrogen Release Compound

MACTEC MACTEC Engineering and Consulting, Inc.

 $\begin{array}{ll} \mu g/L & \text{micrograms per liter} \\ mg/L & \text{milligrams per liter} \\ mV & \text{millivolt} \end{array}$ 

ORP redox potential

PCE perchloroethylene, tetrachloroethene

PVC polyvinyl chloride Redox oxidation-reduction

RCRA Resource Conservation and Recovery Act

RFI RCRA Facility Investigation

TCE trichloroethane
TOC total organic carbon
TPH total petroleum hydrocarbon

USEPA U.S. Environmental Protection Agency

VC vinyl chloride

VOC volatile organic compounds

# 1.0 Introduction

This report presents the results of an enhanced bioremediation pilot study conducted by MACTEC Engineering and Consulting, Inc. (MACTEC) on behalf of McDonnell Douglass, a wholly owned subsidiary of The Boeing Company (Boeing). The objective of the pilot study was to measure the ability of a Hydrogen Release Compound® (HRC) to enhance biological activity of reductive dehalogenating microbes to dechlorinate trichloroethene (TCE) and other chlorinated aliphatic hydrocarbons under anaerobic conditions in shallow groundwater at the Boeing Tract 1 Facility (Facility) located in Hazelwood, Missouri (Figure 1-1). The conclusions and results of the pilot study will assist in the development of a Corrective Measure Study for the Boeing Tract 1 Facility.

# 2.0 Facility Description

The pilot study was conducted at the former Boeing Fabrication Operations Facility (consisting of Buildings 27, 29 and 29A), which is now operated by GKN Aerospace Services. Aircraft components are manufactured at the Fabrications Operations Facility, which has been in operation at the site since 1941. The Fabrication Operations Facility is located on Boeing Tract 1 North, which is bounded on the west by Lindbergh Boulevard, on the south by Banshee Road, and on the east by Coldwater Creek. McDonnell Boulevard bounds the northern portion of the Facility (Figure 2-1).

The Facility is located on generally flat topography in an area known as the Florissant Basin. The Florissant Basin consists of a broad valley cut by the ancestral Coldwater Creek and tributaries. This basin was subsequently in-filled by unconsolidated clay and organic silt deposits approximately 80 feet thick at the Facility. The bedrock unit underlying the unconsolidated deposits consists of Mississippian Age Ste. Genevieve limestone.

At the pilot test area, the surficial material consisted of silty clay. Plasticity in the soil increased with depth from moderate to high between the surface and 20 feet below ground surface (bgs). The upper 15 feet of soil had abundant iron oxidation staining and contained vertical root traces/worm burrows up to 1/8<sup>th</sup> inch diameter that were infilled with iron oxidation. Below 20 feet bgs the surficial material consisted of increasingly plastic clay.

Shallow groundwater at the pilot test area was encountered between 2 and 6 feet bgs. The shallow groundwater gradient is to the east. The average facility-wide hydraulic gradient was calculated at 0.0107 feet per foot and the average facility-wide linear groundwater velocity was calculated at 7.6 feet per year. Additional site characterization data regarding the Boeing Tract 1 Facility is presented in the Draft Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report (MACTEC, 2003).

# 3.0 Technology Description

The most important process for the natural degradation of chlorinated compounds is that of reductive dechlorination. Chlorinated ethenes [tetrachloroethene (PCE), TCE, dichloroethene (DCE), vinyl chloride (VC)] are transformed by sequential dechlorination from PCE to TCE to DCE to VC to ethene (U.S. Environmental Protection Agency (USEPA), 1998). The chlorinated compound is utilized as an electron acceptor, with a chlorine atom removed and replaced with a hydrogen atom. Complete reductive dechlorination produces ethane or methane and carbon dioxide (Figure 3-1).

#### 3.1 Environmental Conditions that Support Reductive Dechlorination

Reductive dechlorination occurs under strongly reducing (anaerobic) conditions and requires carbon as a food source for microbes. Environmental conditions that support reductive dechlorination include:

- Microorganisms capable of degrading the contaminants;
- > Oxidation-reduction (redox) potential of the groundwater;
- > Sufficient electron donors (e.g. a carbon source);
- > Limited competing electron acceptors.

#### 3.1.1 Microorganisms

Reductive dechlorination of chlorinated compounds relies on microorganisms that produce enzymes that degrade the contaminants. Generally, if products of complete dechlorination are evident at a site, microorganisms necessary for dechlorination can be assumed to be present (Wisconsin Department of Natural Resources, 2003). At the Facility, degradation products DCE and VC are present in the shallow groundwater in conjunction with PCE and TCE, indicating that dehalogenating microorganisms are present.

#### 3.1.2 Oxidation-Reduction Potential (ORP)

ORP (redox) of groundwater is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. In general, a groundwater ORP of less than negative 100 millivolts (mV) indicates that a reductive pathway is likely (USEPA, 1998). However, while ORP can indicate the likelihood of reductive dechlorination occurring, the aquifer redox condition cannot predict the extent to which reductive dechlorination will occur (Loffler et al., 1999). At the Facility, ORP in groundwater was measured to be lower than negative 100 mV in several areas where chlorinated compounds were detected.

#### 3.1.3 Carbon Source

Because chlorinated compounds are utilized as electron acceptors during reductive dechlorination, an appropriate carbon source is required for microbial growth (and resulting production of hydrogen) to occur. Potential carbon sources include low molecular weight organic compounds (lactate, acetate, methanol, glucose, etc.), fuel hydrocarbons, or naturally occurring organic matter. At the Facility the geology of the shallow surficial soil consists of silts and clays of lacustrine (lake) origin with a high organic content. Additionally, anthropogenic carbon sources (fuel hydrocarbons such as fuel oil, jet fuel, and cutting oil) are present at the Facility in several areas where chlorinated compounds were detected.

#### **3.1.4** Competing Electron Acceptors

Dissolved oxygen (DO) is the most favored electron acceptor used by microbes for the biodegradation of organic carbon. Anaerobic bacteria generally cannot function at DO concentrations greater than about 0.5 milligrams per liter (mg/L) and, hence, reductive dechlorination will not occur (USEPA, 1998). After depletion of DO, anaerobic microbes will use nitrate as an electron acceptor, followed by iron (III), sulfate, and finally carbon dioxide (methanogenesis). Each sequential reaction drives the ORP of the groundwater downward. Reductive dechlorination typically requires a redox state at least as anaerobic as sulfate reduction.

Excess concentrations of nitrate (greater than one mg/L) and sulfate (greater than 20 mg/L) may cause competitive exclusion of dechlorination. At the Facility, nitrate and sulfate concentrations in groundwater were generally measured to be lower than these potential competitive levels in the areas where chlorinated compounds were detected.

#### 3.2 Enhanced Bioremediation

Enhanced bioremediation is the process of increasing the rate of contaminant degradation through the addition of nutrients or additives that produce conditions supportive of the natural biodegradation process. HRC, a proprietary polylactate ester manufactured by Regenesis, Inc., is a viscous liquid specially formulated for slow release of lactic acid upon contact with water in the subsurface environment. Lactic acid can be metabolized by native microbes to hydrogen, which is a suitable electron donor for the reductive dechlorination process (Koenigsberg and Farone, 1999).

# 4.0 Pilot Test Implementation

#### 4.1 Pilot Area Selection

The pilot test area selected was at the Scrap Metal Recycling Dock at the Fabrication Operations Facility. Chlorinated aliphatic hydrocarbons compounds (TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and VC) were detected in the shallow groundwater at the Recycling Dock along with total petroleum hydrocarbons (TPH). The presence of cis-DCE and VC, compounds not know to have been historically used at the Facility, indicated that reductive dechlorination was naturally occurring in this area with potentially TPH being utilized as a carbon source.

The Scrap Metal Recycling Dock is located west of Building 27 (Figure 2-1) and consists of a concrete lined and curbed area approximately 250 feet long by 30 feet wide where aluminum, titanium, and other metal shavings and scrap from the manufacturing process are loaded into tractor trailers to be hauled off-site to a recycling company. The metal shavings contain cutting oil (currently water based) that is allowed to drain from the trailers into the curbed area prior to shipment. The cutting fluid is collected in a sump that is connected to a series of drain inlets in the concrete pad.

Monitoring Well MW3, located within the concrete curbed area in the Recycle Dock, was installed in July 2000 as part of the RFI. Groundwater from this well was sampled once (at installation) for TPH with a concentration of 1,700 micrograms per liter (µg/L) gasoline range TPH detected. Well MW3 was sampled for volatile organic compounds (VOCs) seven times during quarterly groundwater sampling prior to the pilot test implementation. PCE has never been detected in MW3. TCE concentrations detected in these seven samples ranged between 1,400 µg/L to 8,000 µg/L with an average concentration of approximately 4,000 µg/L. Cis-DCE concentrations ranged from 1,800 to 7,600 µg/L with an average concentration of approximately 3,700 µg/L. VC concentrations ranged from 32 µg/L to 130 µg/L with several non-detects at a detection limit of 100 µg/L. The average VC concentration detected was approximately 87 µg/L. The only other VOCs detected in MW3 were low concentrations of 1,1-dichloroethane (DCA), 1.1-DCE, and trans-DCE which were detected in some of the sampling events. The results of the pre-pilot test groundwater sampling for MW3 are summarized in Table 4-1 and presented graphically in Figure 4-1. Linear curve matching trend lines for each chlorinated compound indicated no increasing or decreasing trends during the two-year period. A complete summary of groundwater sampling analysis and copies of laboratory reports can be found in the Draft RFI report (MACTEC, 2003).

#### **4.2** Pilot Test Design

An area approximately 625 square feet with monitoring well MW3 at the center was chosen as the pilot test area. An injection grid consisting of three rows of three injection borings set 10 feet apart with the middle row staggered 5 feet to the north was planned. The injection grid was located such that MW3 was approximately five feet downgradient (east) of the middle grid row. Due to the location of an underground fire protection water line, the downgradient row of injection borings was located approximately 15 feet east of the center row (Figure 4-2).

The average TCE, cis-DCE and VC concentrations detected in monitoring well MW3, along with additional competing electron acceptor values and additional demand factors such as competing microbial processes and hydrophobic sorbtion were used to calculate the appropriate HRC application rate. Based on the software program provided by Regenesis, an appropriate application rate of 6 pounds per foot in each injection boring was estimated.

In order to provide for monitoring of groundwater upgradient and downgradient of the pilot test area, two additional monitoring wells were installed at the Recycling Dock on June 10, 2002. Monitoring Well MW3A was installed 29 feet west (upgradient) of MW3 and MW3B was installed 24 feet east (downgradient) of MW3 (Figure 4-2). Construction of these two monitoring wells matched that of MW3 except that 15 feet of well screen was used in each instead of 10 feet. MW3A and MW3B were drilled to a depth of 20 feet bgs and completed with 15 feet of two-inch schedule 40 polyvinyl chloride (PVC), 0.001-inch slotted well screen and solid PVC riser to the surface. Sand pack was placed to two feet above the top of the well screen with a one foot bentonite seal on top of the sand pack. The wells were completed at the surface with flush mount well boxes with one-foot skirts set into concrete. Copies of the boring/monitoring well logs for MW3, MW3A, and MW3B are included as Appendix A.

Based on the design of the pilot test presented in the Pilot Test Work Plan, Boeing obtained an Underground Injection Control permit from the Missouri Department of Natural Resources Clean Water Commission for the pilot test project. A copy of the permit is included as Appendix B.

# 4.3 HRC Injection

PSA Environmental of Lee's Summit, Missouri conducted the HRC injection on July 19, 2002 under the direction of a MACTEC geologist. A truck mounted Geoprobe® hydraulic soil probing machine was used to install the injection borings using 1.5-inch diameter steel drive rod fitted with an expendable steel point. Each boring was driven to 19 feet bgs and the drill rod was retracted in approximately 1-foot intervals to 4 feet bgs. In two of the borings, a prototype injection drive rod head was used to allow injection in 1-foot intervals during the downward probing. Approximately six pounds of HRC was injected at each 1-foot interval for a total of 90

pounds per injection boring. The HRC material in 4-gallon buckets (30 pounds of HRC) was heated in a water bath to an approximate temperature of 120° Fahrenheit (°F) to increase the viscosity of the HRC. A Geoprobe® GS2000 pump was used to pump the HRC down the drive rods.

Following completion of HRC injection and removal of the drive rod, each boring was temporarily plugged with a four-foot section of 2x2 wood to keep the HRC from pushing back up the open borehole. After one to two hours, the fluid pressure dissipated, and the boreholes were capped with granular bentonite and the concrete surface patched.

#### 4.4 Groundwater Monitoring

Groundwater samples were collected from the three monitoring wells (MW3, MW3A, and MW3B) the day prior to the HRC injection and monthly thereafter for the next year. A final round of groundwater sampling was conducted in January 2004, 19 months after the HRC injection. Groundwater samples were analyzed VOCs by EPA Method 8260.

Quarterly the groundwater samples were analyzed by the laboratory for 14 inorganic parameters: chloride; dissolved organic carbon (DOC); total organic carbon (TOC); ethane; ethene; free carbon dioxide; iron; dissolved iron; dissolved manganese; methane; nitrate; nitrite; sulfate; and sulfide. Additionally, the groundwater samples were analyzed quarterly for five metabolic acids: lactic acid, pyruvic acid, acetic acid, propionic acid, and butyric acid. These acids are indicators of the breakdown of the HRC. Copies of the laboratory reports and chain-of-custody documents for the January 2004 sampling event and the metabolic acid analysis are included in Appendix C. Copies of laboratory reports for the previous VOC analysis are included in the RFI (MACTEC, 2003).

Groundwater samples were collected using a peristaltic pump and dedicated tubing. When possible, the samples were collected using low flow sampling techniques (USEPA, 1996). If drawdown could not be stabilized in a well, the well was sampled after the removal of three well volumes of groundwater and the stabilization of field parameters. Field parameters measured were temperature, pH, conductivity, redox potential (ORP), DO, and ferrous iron.

Immediately upon collection, each sample was properly labeled to prevent misidentification and placed in a shipping container with sufficient ice or ice packs to maintain an internal temperature of four-degrees Celsius (°C) during transport to the laboratory. A completed chain-of-custody form was placed in each shipping container to accompany the samples to the laboratory. VOC and inorganic analysis were conducted by Environmental Science Corporation in Mt. Juliet, Tennessee. Metabolic acid analysis was conducted by Keystone Laboratories in Newton, Iowa.

#### 4.5 Pilot Study Site Disturbance

On November 20, 2002 (154 days following HRC injection) the underground fire protection water line that runs through the Scrap Metal Recycling Dock failed, resulting in a release of an unknown volume of water. The water line runs through the pilot test area, between the center and east rows of injection points. The water line break occurred approximately 30 feet south of the pilot test area and was repaired within 24 hours by excavating an area approximately 20 feet long (north-south) by 10 feet wide (east-west). The monthly groundwater sampling of the pilot test wells was conducted on November 22, 2002.

#### 5.0 Results

A summary of the target VOC analytical results from the pilot test groundwater samples are presented in Table 5-1 and on Figure 5-1. Results of target VOC analytical molar data and molar ratio data are presented in Tables 5-2 and 5-3 and on Figure 5-2. A summary of inorganic analytical analysis is presented in Table 5-4 and on Figure 5-3. A summary of field parameter measurements is presented in Table 5-5 and on Figure 5-4. Results of metabolic acid analysis are presented in Table 5-6.

# 5.1 Upgradient Well

Monitoring Well MW3A was installed approximately 15 feet upgradient of the HRC injection grid. The results of VOC analysis indicate that chlorinated compound concentrations stayed the same or slightly increased over the 19-month pilot study. TCE concentrations ranged from 150  $\mu$ g/L to 290  $\mu$ g/L, cis-DCE concentrations ranged from 160  $\mu$ g/L to 460  $\mu$ g/L, trans-DCE concentrations ranged from less than one  $\mu$ g/L to 18  $\mu$ g/L, and VC concentrations ranged from less than one  $\mu$ g/L to 13  $\mu$ g/L.

Inorganic analysis and field parameter measurement indicated no discernible trends over the 19-month pilot test with the exception of a one-time drop in the ORP measurement corresponding with the break of the water line just south of the pilot test area. The ORP measurement returned the following month to the normal observed range.

# 5.2 VOC Analysis

The results of laboratory VOC analysis indicated that TCE concentrations declined 98 percent in MW3 by the first sampling event at 28 days post injection and were more than 99 percent lower through each of the subsequent 11 months. TCE concentration in MW3 at 19-months remained 98.7 percent lower than prior to injection. TCE concentrations declined 100 percent in MW3B by the first sampling event at 28 days post injection and remain below detection limit at 19-months.

The decline in TCE in MW3 was matched by an initial increase in cis-DCE over the first two months after injection. Three months after injection, cis-DCE concentrations declined significantly in MW3 and MW3B with a corresponding increase in vinyl chloride. The vinyl chloride concentration increased in MW3 though the eighth month of the pilot test (February 2003) and declined over the following eight months. The vinyl chloride concentration in MW3B declined each month starting with eighth month after injection.

#### 5.3 Molar Ratio

In an attempt to evaluate the degradation process molar ratio percentages of the chlorinated VOCs through time were assessed. Molar ratios between parent compound and daughter product should remain constant if no biodegradation is occurring. Molar ratio percentages provide a view of the relative proportions of an analyte to the sample as a whole. The total number of moles of organic compounds in a sample is the sum of the moles for each of the analytes (Table 5-2). In order to obtain the molar ratio percentage the concentration of the analyte is divided by its molecular weight to give the number of moles of that analyte in the sample. The molar ratio percentage is obtained by dividing the number of moles of an analyte by the total number of moles of organic compounds in the sample (Table 5-3). Only the targeted analytes (TCE, cis-DCE, and VC) were included in this molar ratio percentage evaluation.

Figure 5-2 presents a graphical presentation of the molar percentages for the analytical results. Monitoring Well MW3A, the upgradient well, shows relatively consistent molar ratio composition throughout the pilot test. Wells MW3 and MW3B both show a decrease in the percentage of TCE after the first 30 days and an increase in the percentage of VC between the third and ninth months post injection with a decrease in VC percentage throughout the remainder of the pilot test, indicative of enhanced reductive dechlorination.

## 5.4 Inorganic Analysis

A summary of inorganic analysis for the three wells in the pilot test in addition to one non-impacted monitoring well (MW9S) located nearby (approximately 150 feet away) is presented in Table 5-4. Five inorganic compounds useful in the evaluation of the reductive dechlorination stimulated by the injection of HRC at the pilot test area are graphed on Figure 5-3. Ethene was detected in MW3 in both the nine-month and 12-month sampling events and ethane was detected in the nine month sampling, corresponding with the observed decrease in VC, further evidence of the complete dechlorination of VC. The inorganic analysis observed suggests that the effect of the HRC in MW3 began to decline between nine and 12 months post injection as indicated by the slight increase of sulfate concentrations and the return of TOC concentrations to background levels. However, the results of VOC analysis and field parameter measurement indicate that conditions remain favorable for reductive dechlorination and that chlorinated compound degradation is continuing.

#### 5.5 Field Parameters

Field parameters measurements were collected each sampling event and are summarized in Table 5-5. The pH, specific conductivity, and ferrous iron content remained generally consistent in MW3 and MW3B over the course of the pilot test. The DO declined in both MW3 and MW3B

and remained below the pre-injection value with the exception for an increase in DO for approximately 30 days following the water line break. ORP declined in both MW3 and MW3B and remained below the pre-injection value for the duration of the pilot test, although the OPR levels did increase slightly in MW-3 and MW-3B following the water line break.

### 5.6 Metabolic Acid Analysis

HRC is a polylactic ester that breaks down into volatile acids: acetic, butyric, lactic, propionic, and pyruvic. Metabolic analysis indicated that acids were not detected in the four post injection quarterly sampling events. Additionally, lactic acid was not detected in a groundwater sample collected from well MW3 in October 2001. Lactic acid was detected in the sampling conducted on monitoring well MW3 immediately prior to the injection, this anomalous result may be the result of cross-contamination or laboratory error. The lack of detectable acid concentrations in the post injection sampling may indicate that HRC was quickly being completely broken down to levels below the laboratory detection limit.

### 6.0 Conclusions

The results of the pilot test provide definitive evidence that reductive dechlorination is occurring within the test area and that the injection of HRC greatly accelerated the rate of chlorinated compound degradation.

- The dechlorination process was observed to go to completion with the reduction of TCE → cis-DCE → VC → ethene → ethane. Clear evidence that reductive dechlorination was going to completion was the detection of ethene and/or ethane in MW-3 in the two samples (March and June of 2003) analyzed for these constituents following the onset of vinyl chloride reduction in the well. Note that ethane and ethene was not detected in January 2004 but that the method detection limit was elevated (10 mg/L) for this analysis. Additionally, the low concentration of vinyl chloride present in MW-3B, would probably preclude the detection of ethane or ethene above the method detection limit of one mg/L.
- Additional evidence that complete dechlorination is occurring is that the vinyl chloride concentrations remained unchanged between the June 2003 and January 2004 sampling event in MW-3 while the cis-DCE concentration declined in this well by 37 percent. Since the vinyl chloride concentration did not change over this period, the vinyl chloride that was created by the reduction of the cis-DCE was offset by the dechlorination of vinyl chloride.
- Based on the reduction in TOC concentrations to pre-injection levels and the slight increase in sulfate observed in monitoring well MW3, the majority of HRC may have been consumed by the 12<sup>th</sup> month. However, the conditions for reductive dechlorination (low DO, redox potential, and limited competing electron donors) remain and that reductive dechlorination is still occurring as evidenced by the continued chlorinated compound degradation observed through the 19<sup>th</sup> month in both monitoring wells MW3 and MW3B.
- For Groundwater immediately upgradient to the pilot area was unaffected by the pilot test. However, the VOC concentrations present in the upgradient well (MW3A) are an order of magnitude or more lower than the concentrations present prior to the pilot test in MW3 and continued reductive dechlorination is expected as the groundwater migrates into the anaerobic conditions of the pilot test area.
- The DO went up in monitoring wells MW-3 and MW-3B in the samples collected immediately after and 30 days after the water line break. This increase in DO is most likely the result of influence from the water line break and may have temporarily slowed the reductive dechlorination process. However, the DO levels in these two wells returned to low levels in the sampling conducted approximately 60 days after the line break and remained at favorably low levels for the remainder of the pilot test. Therefore, the water line break did not appear to have any long term effect on the results of the pilot test.

- The graphs of the detected VOC constituents provide indirect evidence that desorbtion of TCE from the soil below the groundwater table occurred for a period of time in monitoring well MW3. Given that TCE tends to degrade faster than DCE, if desorbtion is occurring, DCE will build up in the system over time. Initially, DCE concentrations rose in well MW3 over the first two month post injection, consistent with the observed rapid degradation of TCE in groundwater. The DCE concentrations declined significantly between the second and third month as the DCE was reduced at a faster rate than it was produced, TCE in groundwater had declined by more than 99 percent over this time. DCE concentrations started to go up beginning the fourth month through the 12<sup>th</sup> month indicating that DCE was being produced at a rate higher than it was degraded, most likely by the degradation of TCE desorbed from the soil. DCE concentrations fell between the 12<sup>th</sup> and 19<sup>th</sup> month indicating that TCE desorbtion was declining as TCE was removed from the soil.
- This trend of DCE build up was not observed in the downgradient well (MW3B) which indicates that desorbtion of TCE from the soil was not occurring at that location. Note that well MW3B is located outside of the source area (inside the curbed area at the Recycle Dock) and that screening of soil samples collected during the drilling of MW3B did indicate the presence of organic vapors in the soil.

#### 7.0 References

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- Wisconsin Department of Natural Resources. 2003. Understanding Chlorinated Hydrocarbon Behavior in Groundwater: Investigation, Assessment and Limitations of Monitored Natural Attenuation. RR-699. April.

**Tables** 

Table 4-1 Summary of Laboratory Pre-Pilot Test Target VOC Data ( $\mu$ g/L), Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date:	06/19/02						
	Sampling Date	07/28/2000	01/10/2001	05/09/2001	07/24/2001	10/25/2001	03/06/2002	06/18/2002
Well	Days Since Injection	-691	-525	-406	-330	-237	-105	-1
ID	Parameter				Results (μg/I	.)		
	PCE	<100	<5	<100	<1	<25	<1	<100
	TCE	1,700	6,900	3,500	2,700	8,000	1,400	3,900
MW3	cis-1,2-DCE	2,100*	6,000	2,600	2,600	7,600	1,800	3,300
	trans-1,2-DCE	NA	91	<100	62	260	67	<100
	VC	32	120	<100	81	130	75	<100
	Total VOC	1,732	13,111	6,100	5,443	15,990	3,342	7,200

MACTEC, 2004

Notes:

PCE - Tetrachloroethene

TCE - Trichloroethene

cis-1,2-DCE - cis-1,2-Dichloroethene

VC - Vinyl chloride

\* - Result of total 1,2-DCE analysis

VOC - Volatile Organic Compound

NA - Not analyzed

< - Not detected above the indicated concentration

 $\mu g/L$  - micrograms per liter

Table 5-1 Summary of Laboratory Target VOC Data (µg/L), Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date:	06/19/2002														
*** 11	Sampling Date	06/18/2002	07/18/2002	08/15/2002	09/23/2002	10/15/2002	11/22/2002	12/16/2002	01/20/2003	02/20/2003	03/17/2003	04/17/2003	05/19/2003	06/18/2003	01/14/2004	D.
Well	Days Since Injection	-1	29	57	96	118	156	180	215	246	271	302	334	364	574	Percent
ID	Parameter							Results (µ	g/L)	- 1						Change
MW3A	PCE TCE cis-1,2-DCE trans-1,2-DCE VC Total VOC	<1 190 160 9.8 4.9	<1 220 240 12 5.9	<1 240 270 14 5.3 529.3	<1 150 200 12 4.8 366.8	<5 170 260 10 6	<1 190 290 12 7.5 499.5	<10 230 320 14 <10	<1 240 340 17 6.7	<1 220 290 12 9.3 519.3	<1 220 270 14 7.1 497.1	<1 150 220 11 8.9 389.9	<1 220 320 18 8.7 566.7	<1 260 360 18 9.9	<1 290 460 <1 13	0% 52.6% 187.5% -100.0% 165.3%
MW3	PCE TCE cis-1,2-DCE trans-1,2-DCE VC Total VOC	<100 3,900 3,300 <100 <100 7,200	<50 210 3,800 73 <50 4,083	<50 51 4,900 110 84	<1 8 1,300 34 440	<5 <5 2,200 44 1,400 3,644	<25 33 2,100 39 1,100 3,272	<5 5.8 1,600 47 1,300 2,953	<1 5.2 2,300 54 1,600 3,959	<1 9.7 2,700 59 2,700 5,410	<1 6.4 2,700 53 2,100 4,806	<50 <50 2,900 <50 1,600	<5 9.1 3,600 77 1,400 5,086	<1 7.3 4,100 68 1,000 5,175	<1 34.0 2,600 100 1,000 3,734	0% -98.7% -21.2% 0.0% 3900% -48.1%
MW3B	PCE TCE cis-1,2-DCE trans-1,2-DCE VC Total VOC	<1 8.5 130 2.7 1.2 142.4	<1 2.1 100 1.7 <1 103.8	<2 <2 86 <2 <2 <2	<1 <1 65 1.5 2.5	<1 <1 53 1.5 15	<1 1.1 30 1.4 15	<1 <1 27 1.4 11 39.4	<1 <1 27 1.5 15 43.5	<1 <1 19 <1 12	<1 <1 15 1.1 7.7 22.7	<1 <1 13 <1 6.4 19.4	<1 <1 16 <1 5.8 21.8	<1 <1 16 1.1 4.2 21.3	<1 <1 6.2 <1 1.8	0% -100.0% -95.2% -100.0% 50.0% -94.4%

Notes:

PCE - Tetrachloroethene

TCE - Trichloroethene

cis-1,2-DCE - cis-1,2-Dichloroethene

trans-1,2-DCE - trans-1,2-Dichloroethene

VC - Vinyl chloride

VOC - Volatile Organic Compound

μg/L - micrograms per liter

< - Not detected above the indicated concentration

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Table 5-2 Summary of Target VOC Molar Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	I	njection Date:	06/19/02													
	S	ampling Date	06/18/02	07/18/02	08/15/02	09/23/02	10/15/02	11/22/02	12/16/02	01/20/03	02/20/03	03/17/03	04/17/2003	05/19/2003	06/18/2003	01/14/2004
Well	Days S	ince Injection	-1	29	57	96	118	156	180	215	246	271	302	334	364	574
ID	Parameter	mol. Wt. (g/mol)							Result	s (μmol/L)						
	PCE	165.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TCE	131.39	1.4	1.7	1.8	1.1	1.3	1.4	1.8	1.8	1.7	1.7	1.1	1.7	2.0	2.2
MW3A	cis-1,2-DCE	96.94	1.7	2.5	2.8	2.1	2.7	3.0	3.3	3.5	3.0	2.8	2.3	3.3	3.7	4 7
	VC	62.50	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2
		Total	3.2	4.2	4.7	3.3	4.1	4.6	5.1	5.4	4.8	4.6	3.6	5.1	5.9	7.2
	PCE	165.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MW3	TCE	131.39	29.7	1.6	0.4	0.1	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.3
	cis-1,2-DCE	96.94	34.0	39.2	50.5	13.4	22.7	21.7	16.5	23.7	27.9	27.9	29.9	37.1	42.3	26.8
	VC	62.50	0.0	0.0	1.3	7.0	22.4	17.6	20.8	25.6	43.2	33.6	25.6	22.4	16.0	16.0
		Total	63.7	40.8	52.3	20.5	45.1	39.5	37.3	49.4	71.1	61.5	55.5	59.6	58.3	43.1
	PCE	165.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MW3B	TCE	131.39	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IVI VV 3D	cis-1,2-DCE	96.94	1.3	1.0	0.9	0.7	0.5	0.3	0.3	0.3	0.2	0.2	0.1	0.2	0.2	0.1
	VC	62.50	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.0
		Total	1.4	1.0	0.9	0.7	0.7	0.5	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.1
			·			·									N	1ACTEC, 2004

Notes:

cis-1,2-DCE - cis-1,2-Dichloroethene

g/mol - grams per mole

 $\mu mol/L$  - micromole per liter

PCE - Tetrachloroethene

TCE - Trichloroethene

VC - Vinyl chloride

a. - For those results less than the laboratory reporting limit, numeric zeros were listed as results and were used for graphing purposes. Detection limits are subject to variation due to sample matrix interference and sample dilution.

02/06/2004

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Table 5-3 Summary of Target VOC Molar Percentage Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

Days Since In rameter (s	(g/mol) 165.83 131.39	06/18/02 -1 0.00% 45.55%	07/18/02 29	08/15/02	09/23/02	10/15/02 118	11/22/02 156	12/16/02 180	01/20/03 215	02/20/03	03/17/03	04/17/03 302	05/19/03	06/18/03 364	01/14/04 574
rameter me	mol. Wt. (g/mol) 165.83 131.39	0.00%			96	118			215	246	271	302	334	364	574
DCE	(g/mol) 165.83 131.39		0.00%				Рото								9 45-22-15-71-10-1
DCE	131.39		0.00%				rerce	ent (%) of To	otal Moles						
			39.45%	0.00% 38.89%	0.00% 34.79%	0.00% 31.78%	0.00% 31.73%	0.00% 34.65%	0.00% 33.57%	0.00% 34.78%	0.00% 36.61%	0.00% 32.13%	0.00% 32.74%	0.00%	0.00% 30.83%
	96.94 62.50	51.98% 2.47%	58.33% 2.22%	59.30% 1.81%	62.87% 2.34%	65.87% 2.36%	65.64% 2.63%	65.35% 0.00%	64.46% 1.97%	62.13% 3.09%	60.90% 2.48%	63.86% 4.01%	64.54% 2.72%	63.47% 2.71%	66.27% 2.91%
	Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
DCE	165.83 131.39 96.94 62.50	0.00% 46.58% 53.42% 0.00%	0.00% 3.92% 96.08% 0.00%	0.00% 0.74% 96.69% 2.57%	0.00% 0.30% 65.38% 34.32%	0.00% 0.00% 50.32% 49.68%	0.00% 0.64% 54.82% 44.54%	0.00% 0.12% 44.19% 55.69%	0.00% 0.08% 48.06% 51.86%	0.00% 0.10% 39.16% 60.74%	0.00% 0.08% 45.29% 54.63%	0.00% 0.00% 53.89% 46.11%	0.00% 0.12% 62.30% 37.58%	0.00% 0.10% 72.48% 27.42%	0.00% 0.60% 62.26% 37.14%
The state of the s	Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
	165.83 131.39 96.94 62.50	0.00% 4.54% 94.11% 1.35% 100.00%	0.00% 1.53% 98.47% 0.00% 100.00%	0.00% 0.00% 100.00% 0.00%	0.00% 0.00% 96.30% 3.70% 100.00%	0.00% 0.00% 77.94% 22.06% 100.00%	0.00% 1.77% 65.49% 32.74% 100.00%	0.00% 0.00% 71.05% 28.95% 100.00%	0.00% 0.00% 64.29% 35.71% 100.00%	0.00% 0.00% 61.29% 38.71% 100.00%	0.00% 0.00% 66.08% 33.92% 100.00%	0.00% 0.00% 67.01% 32.99%	0.00% 0.00% 73.39% 26.61% 100.00%	0.00% 0.00% 79.21% 20.79% 100.00%	0.00% 0.00% 77.50% 22.50% 100.00%
		131.39 96.94 62.50	131.39 4.54% 96.94 94.11% 62.50 1.35%	131.39 4.54% 1.53% 96.94 94.11% 98.47% 62.50 1.35% 0.00%	131.39     4.54%     1.53%     0.00%       96.94     94.11%     98.47%     100.00%       62.50     1.35%     0.00%     0.00%	131.39     4.54%     1.53%     0.00%     0.00%       96.94     94.11%     98.47%     100.00%     96.30%       62.50     1.35%     0.00%     0.00%     3.70%	131.39     4.54%     1.53%     0.00%     0.00%     0.00%       96.94     94.11%     98.47%     100.00%     96.30%     77.94%       62.50     1.35%     0.00%     0.00%     3.70%     22.06%	131.39     4.54%     1.53%     0.00%     0.00%     0.00%     1.77%       96.94     94.11%     98.47%     100.00%     96.30%     77.94%     65.49%       62.50     1.35%     0.00%     0.00%     3.70%     22.06%     32.74%	131.39     4.54%     1.53%     0.00%     0.00%     0.00%     1.77%     0.00%       96.94     94.11%     98.47%     100.00%     96.30%     77.94%     65.49%     71.05%       62.50     1.35%     0.00%     0.00%     3.70%     22.06%     32.74%     28.95%	131.39     4.54%     1.53%     0.00%     0.00%     1.77%     0.00%     0.00%       96.94     94.11%     98.47%     100.00%     96.30%     77.94%     65.49%     71.05%     64.29%       62.50     1.35%     0.00%     0.00%     3.70%     22.06%     32.74%     28.95%     35.71%	131.39     4.54%     1.53%     0.00%     0.00%     0.00%     1.77%     0.00%     0.00%     0.00%       96.94     94.11%     98.47%     100.00%     96.30%     77.94%     65.49%     71.05%     64.29%     61.29%       62.50     1.35%     0.00%     0.00%     3.70%     22.06%     32.74%     28.95%     35.71%     38.71%	131.39     4.54%     1.53%     0.00%     0.00%     0.00%     1.77%     0.00%     0.00%     0.00%     0.00%       96.94     94.11%     98.47%     100.00%     96.30%     77.94%     65.49%     71.05%     64.29%     61.29%     66.08%       62.50     1.35%     0.00%     0.00%     3.70%     22.06%     32.74%     28.95%     35.71%     38.71%     33.92%	131.39     4.54%     1.53%     0.00%	131.39     4.54%     1.53%     0.00%	131.39     4.54%     1.53%     0.00%     0.00%     0.00%     1.77%     0.00%

**Notes:** 

PCE - Tetrachloroethene

TCE - Trichloroethene

cis-1,2-DCE - cis-1,2-Dichloroethene

VC - Vinyl chloride

g/mol - Grams per mole

mol. Wt. - Molecular weight

a. - For those results less than the laboratory reporting limit, numeric zeros were listed
as results and were used for graphing purposes. Detection limits are subject to
variation due to sample matrix interference and sample dilution.

Table 5-4 Summary of Laboratory Groundwater Quality Parameter Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date:	06/19/2002 01/10/2001	05/09/2001	07/24/2001	10/25/2001	03/06/2002	06/18/2002	08/15/2002	12/16/2002	03/17/2003	06/18/2003	01/14/200
Well	Sampling Date‡ Days Since Injection	-525	-406	-330	-237	-105	-1	57	180	271	364	57
ID		-525	100		7		Results (mg	/L)				
	Parameter										690	69
	Chloride	NI	NI	NI	NI	NI	480 2.3	640 1.1	610 1.7	550 1.0	1.2	2.
	DOC	NI	NI	NI	NI NI	NI NI	2.2	1.1	1.6	1.4	1.2	1.
	TOC	NI	NI	NI NI	NI		<1	<1	<1	<1	<1	<1
	Ethene	NI	NI NI	NI	NI		<1	<1	<1	<1	<1	<1
	Ethane	NI NI	NI	NI	NI		<1	<1	<1	<1	<1	
	Methane Manganese (disolved)	NI	NI	NI	NI		1.2	1.3	0.73	0.84	0.8	0.
MW3A	Iron (total)	NI	NI	NI	NI	NI	0.89	74	0.037	0.069	0.053	<0.0
	Iron (dissolved)	NI	NI	NI	NI		< 0.02	0.22	<0.02	<0.05	<0.05 0.19	0.0
	Nitrate (as N)	NI	NI	NI	NI		0.48	<0.1	0.288	<0.1 <0.1	<0.19	<(
	Nitrite (as N)	NI	NI	NI	N		<0.1	<1.0 95	<2.5 95.9	95	92	
	Sulfate	NI	NI	NI	N		<b>85</b> < 0.10	<0.02	<0.02	< 0.05	< 0.05	<0.
	Sulfide	NI	NI	NI NI	N N		150	120	160	170	130	1
	Free Carbon Dioxide	NI	NI						590	530	530	4
	Chloride	417	395		490		450	430 7.1	2.3	1.6	1.4	
	DOC	<1	1.8			2 1	1.8 1.6		2.5	2.1	<1.0	
	TOC	1	1.85		1.3 NA		<1	<1	<1	1.3	7.9	
	Ethene	NA	NA NA	NA NA	N/ N/		<1		<1	1.2	<1	
	Ethane	NA NA	NA NA		N/		<1	<1	<1	78	<1	
	Methane	NA NA			N/		2.1	1.8	1.9	2.0	1.9	
MW3	Manganese (disolved) Iron (total)	3.4		NA	5		4.9		5.5	5.8	5.3	
	Iron (dissolved)	NA		. NA	N/	NA NA	< 0.02				1.1	<
	Nitrate (as N)	< 0.03	< 0.1		<0.		<0.1		<0.1	<0.1 <0.1	<0.1	<
	Nitrite (as N)	< 0.03			<0.		<0.1			28	39	
	Sulfate	73.9			8		<0.1				< 0.05	0.0
	Sulfide	NA.		The second secon	NA NA		150		130		120	
	Free Carbon Dioxide	NA.									1,000	1,4
	Chloride	N					840			N .	<1,000	1,-
	DOC	N					1.4				<1	
	TOC	N N									<1	
	Ethene	N N					<				<1	
	Ethane	N					<	1 <			<1	
MANAD	Methane Manganese (disolved)	N				NI NI					5.2	
MW3B	Iron (total)	N				NI NI					7.9	
	Iron (dissolved)	N				NI NI					<0.1	
	Nitrate (as N)	N			100	NI NI					<0.2	
	Nitrite (as N)	N				NI NI					34	
	Sulfate	N				NI N					<0.05	<
	Sulfide	N		-		NI N					77	
	Free Carbon Dioxide							5,200	5,500	5,200	5,400	
	Chloride	N									1.3	
	DOC	N				IS NS						
	TOC	N				IS NS					<1	
	Ethene	N N				NS NS		:1 <		1 <1		
	Ethane	N N				NS NS	<	:1 <				
MANAGE	Methane Manganese (disolved)	N		_		NS NS						
MW9S	Iron (total)	N			S N	NS NS			8 N.			
	Iron (dissolved)	N	S N	S N		NS N						
	Nitrate (as N)	N				NS N		<1 <0				
	Nitrite (as N)		IS N			NS N		<1 <1 40 14				
	Sulfate		IS N			NS N						
	Sulfide		IS N									0
	Free Carbon Dioxide	N	IS N	S N	5	NS N	2:	1	0,			MAG

DOC - Dissolved organic carbon

TOC - Total organic carbon

N - Nitrogen

< - Not detected above the indicated concentration

NI - Well not installed

NA - Not analyzed

NS - Not sampled

mg/L - milligrams per liter ‡ - Samples may be collected on two consecutive days. The first day of sampling is used for the sampling date on this table and for the dates plotted on the attached figures.

Table 5-5 Summary of Field Groundwater Quality Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date: 0	6/19/2002														
Well ID	Collection Date‡  Days Since Injection	06/18/2002 -1	07/18/2002	08/15/2002 57	09/23/2002	10/15/2002	11/22/2002	12/16/2002	01/20/2003	02/20/2002	004					
	Parameter		2)	5/	96	118	156	180	215	02/20/2003	03/17/2003 271	04/17/2003 302			01/14/2004	
	Final pH Final Conductivity (uS)	7.03	6.74	6.71	6.66	674		Results				302	334	364	574	Optim Valu
MINISA	Final Temperature (C) Final Dissolved Oxygen (mg/L) Final ORP (mvolts)	2,380 19.4 4.12	2,510 20.2	2,810 21.7 0.34	2,830 22.7 0.87	6.74 2,720 20.5	<b>6.79</b> 2,840 17.5	<b>6.79</b> 2,240 15.3	<b>6.63</b> 2,840 12.9	2,650	<b>6.76</b> 2,840	<b>6.75</b> 2,820	<b>6.76</b> 2,860	6.87 2,850	<b>6.06</b> 2,990	Pil
	Ferrous (Fe2+) Iron (mg/L) Total Volume Purged (gallons)	64 0.4 8.0	-11 0.8 9.0	11 0.0	-14 NS	0.12 74 0.0	0.79 -185 0.0	0.89 -7 0.2	<b>0.0</b> 115	12.2 0.2 100	14.2 0.6 46	14.9 0.25 60	17.9 <b>0.0</b> 47	20.5	14.3 0.65	NA >20 <0.5
	Final pH  Final Conductivity (uS)  Final Temperature (C)	<b>6.88</b> 2,450	<b>6.80</b> 2,360	6.75 2,270	13.5 6.72 2,450	6.78	6.81	2.5	0.0 2.25 6.76	0.0 2 6.78	3.25	0.4 4.5	0.4 2.5	0.2 3.5	26 0.0 2.5	<-10 >1
I	Final Dissolved Oxygen (mg/L) Final ORP (mvolts)	20.1 0.34 -40	22.3 0.0 -209	21.8 0.2 -145	22.0 0.52	2,330 22.0 0.0	2,260 20.1 1.28	1,930 16.3 1.44	2,470 15.4 <b>0.0</b>	2,490 15	2,520 15.3	<b>6.95 2,490</b> 15.1	<b>6.83</b> 2,490 18.4	2,420 20.9	7.34 2,400	5 < pH . NA
	Ferrous (Fe2+) Iron (mg/L) Total Volume Purged (gallons) Final pH	3.2 2	2.8 1.3	2.8 7	-185 NS 1.5	-237 2.6 2.5	-305 3 7.5	-151 2.2	-166 3.4	0.07 -139 2.4	0.0 -182 1.6	0.31 -151 2.8	0.0 -244 3.0	0.0 -183	16.8 0.25 -206	>20 <0.5 <-100
AW2D F	Final Conductivity (uS) Final Temperature (C)	6.71 3,400 24.5	6.59 3,320 21.4	6.54 3,470 22.9	6.45 3,550 24.6	<b>6.55</b> 3,410	<b>6.56</b> 3,310	6.53 2,580	2.5 6.61 3,390	2.5 6.61	2.5 6.67	2.5 6.53	1.5	3.4 2.0 6.63	7.5 7.6	>1
F	rinal Dissolved Oxygen (mg/L) rinal ORP (mvolts) rerrous (Fe2+) Iron (mg/L)	2.25 23 2.4	0.0 -96 2.6	<b>0.38</b> -84	<b>0.38</b> -73	22.6 0.0 -79	18.6 <b>0.45</b> -56	16.6 1.11 -99	14.8 <b>0.0</b>	3,220 14.2 <b>0.21</b>	3,550 15.8 0.02	3,600 15.3 <b>0.25</b>	3,630 18.8 <b>0.0</b>	3,760 21.3	4,290 16.2	5 < pH < NA >20
	otal Volume Purged (gallons) otes:	2.8	8.8	9	NS 1.5*	<b>2.6</b> 3	2.4 3.25	2.8 2.5	-28 <b>2.6</b> 1.75	3.2 2.25	-43 2 2.75	-23 2.8 3.75	-69 <b>2.6</b> 2.3	0.0 -62 4.6	0.61 -50 <b>5.6</b>	<0.5 <-100 >1

C - Degrees Celsius

mvolts - millivolts

uS - microsiemens NS - Not sampled

mg/L - milligrams per liter

ORP - Oxidation Reduction Potential

Bold - Indicates result in optimum value range

‡ Samples may be collected on two consecutive days. The first day of sampling is used for the sampling date on this table and for the dates plotted on the attached figures.

P:\5100098\HRC\PilotTestRenortTables.xls

02/06/2004

Table 5-6 Summary of Metabolic Acid Analysis Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date: 6	5/19/2002					
	Sampling Date <sup>a</sup>	10/25/2001	6/18/2002	9/23/2002	12/16/2002	3/18/2003	6/18/2003
Well	Days Since Injection	-236	-1	96	180	272	364
ID	Parameter			Results	(mg/L)		
	Acetic Acid	NI	<1	<1	<1	<1	<1
MW3A	Butyric Acid	NI	<1	<1	<1	<1	<1
IVI VV JA	Lactic Acid	NI	<1	<1	<1	<1	<1
	Propionic Acid	NI	<1	<1	<1	<1	<1
	Pyruvic Acid	NI	< 0.1	< 0.1	<0.1	<0.1	<0.1
	Acetic Acid	NA	<1	<1	<1	<1	<1
MW3	Butyric Acid	NA	<1	<1	<1	<1	<1
IVI VV 3	Lactic Acid	<1	26.6	<1	<1	<1	<1
	Propionic Acid	NA	<1	<1	<1	<1	<1
	Pyruvic Acid	NA	< 0.1	< 0.1	<0.1	<0.1	<0.1
	Acetic Acid	NI	<1	<1	<2	<1	<1
MW3B	Butyric Acid	NI	<1	<1	<2	<1	<1
IVI VV SD	Lactic Acid	NI	<1	<1	<2	<1	<1
	Propionic Acid	NI	<1	<1	<2	<1	<1
	Pyruvic Acid	NI	< 0.1	< 0.1	< 0.2	< 0.1	<0.1

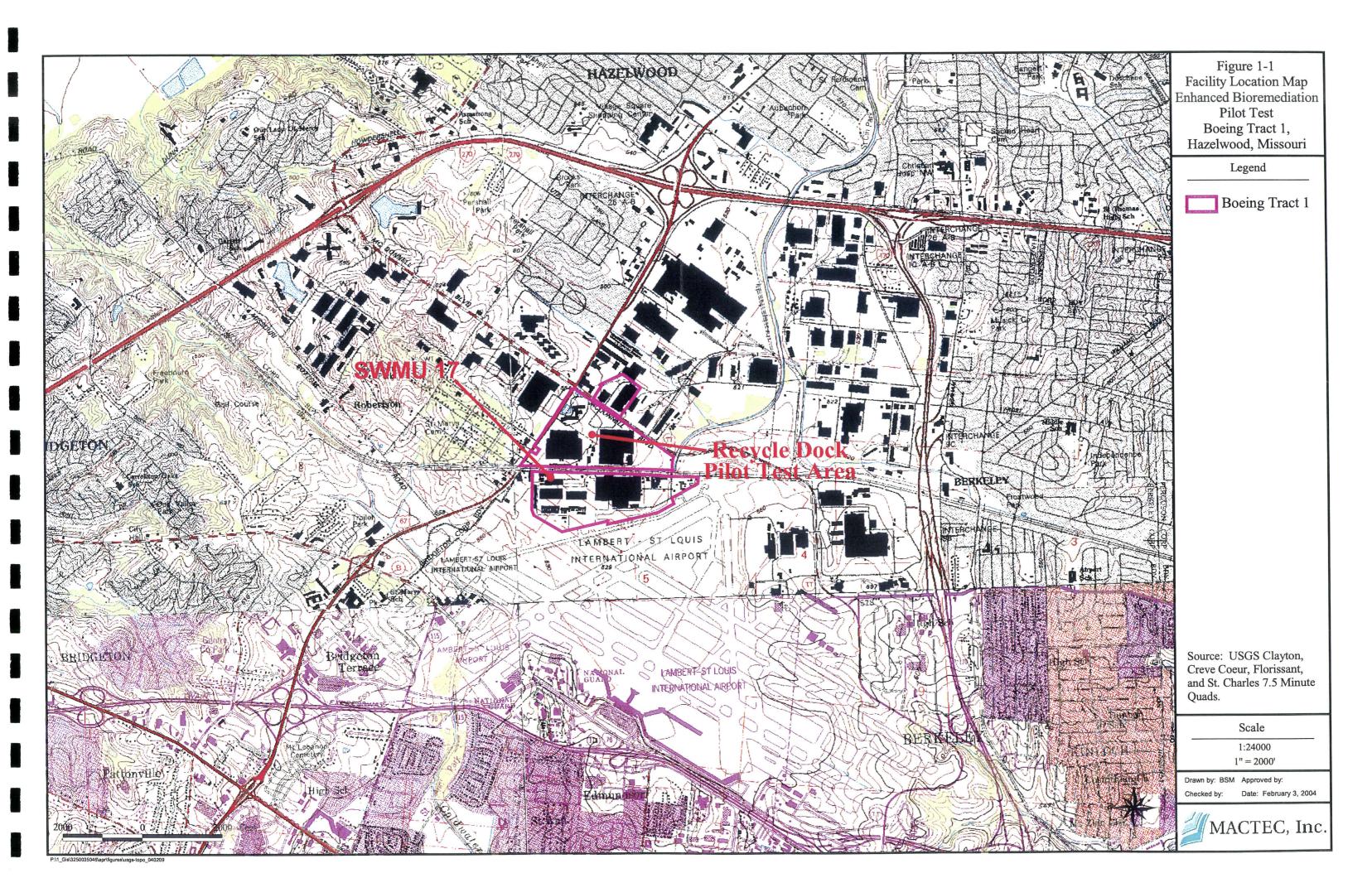
MACTEC, 2004

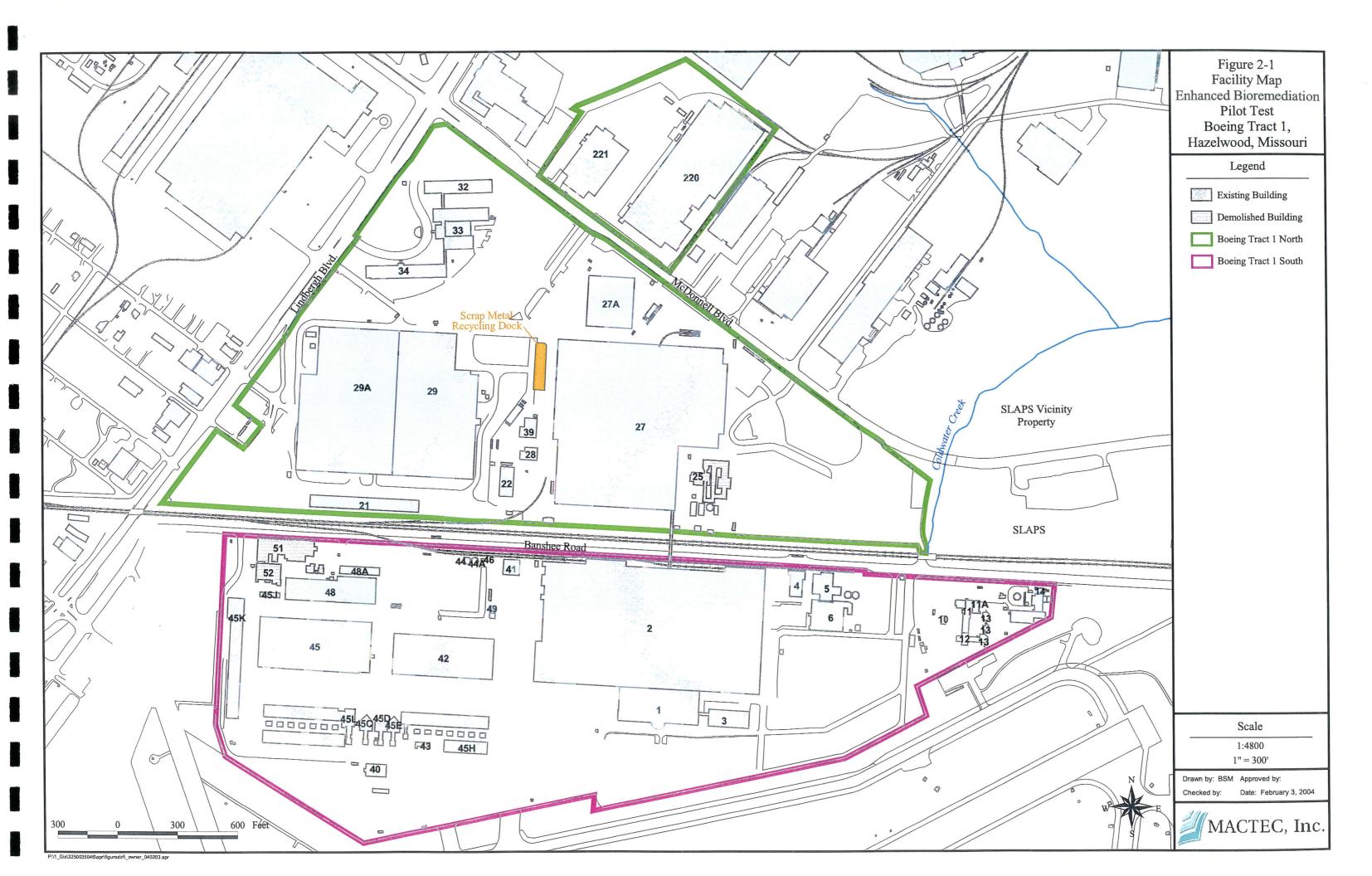
#### Notes:

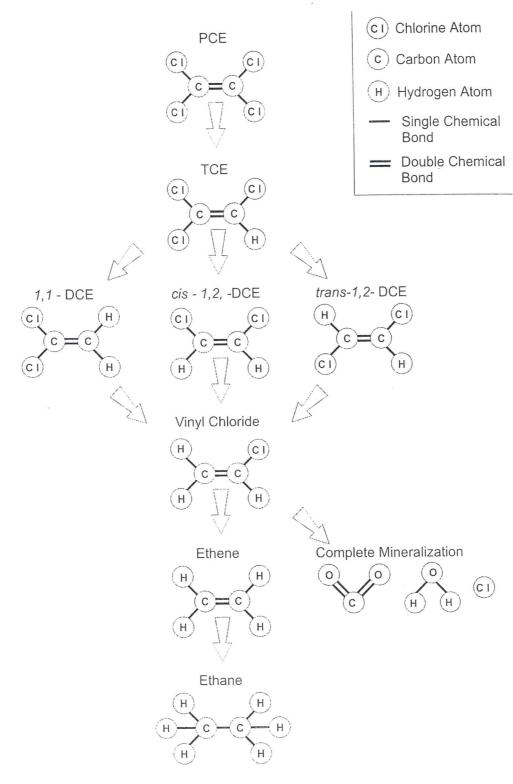
- < Not detected above the indicated concentration
- NI Well not installed
- NA Not analyzed
- a. Samples may be collected on seperate days. The date that MW3 was sampled is used for the sampling date on this table and for the dates plotted on the attached figures.

mg/L - milligrams per liter

**Figures** 







Source: USEPA, 1998

Figure 3-1
Reduction Dehalogenation of Chlorinated
Ethenes

**Enhanced Bioremediation Pilot Test** 

**Boeing Tract 1** 

Hazelwood, Missouri

Drawn by: DLB Checked by: LMS

Approved by:

Date: 2/4/2004



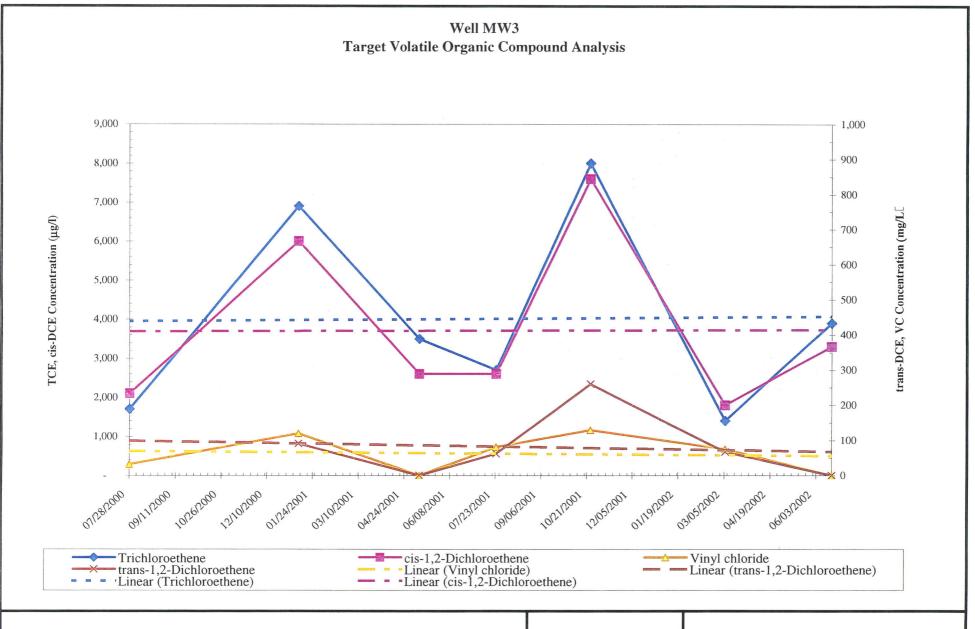
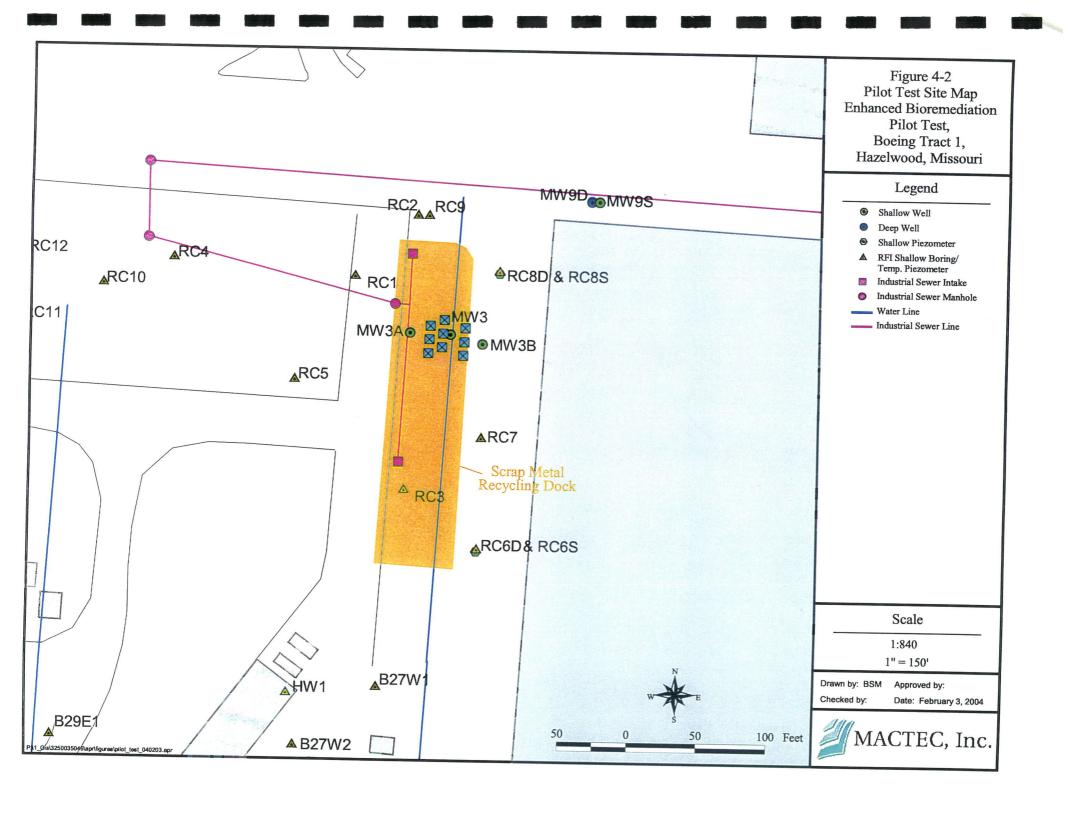
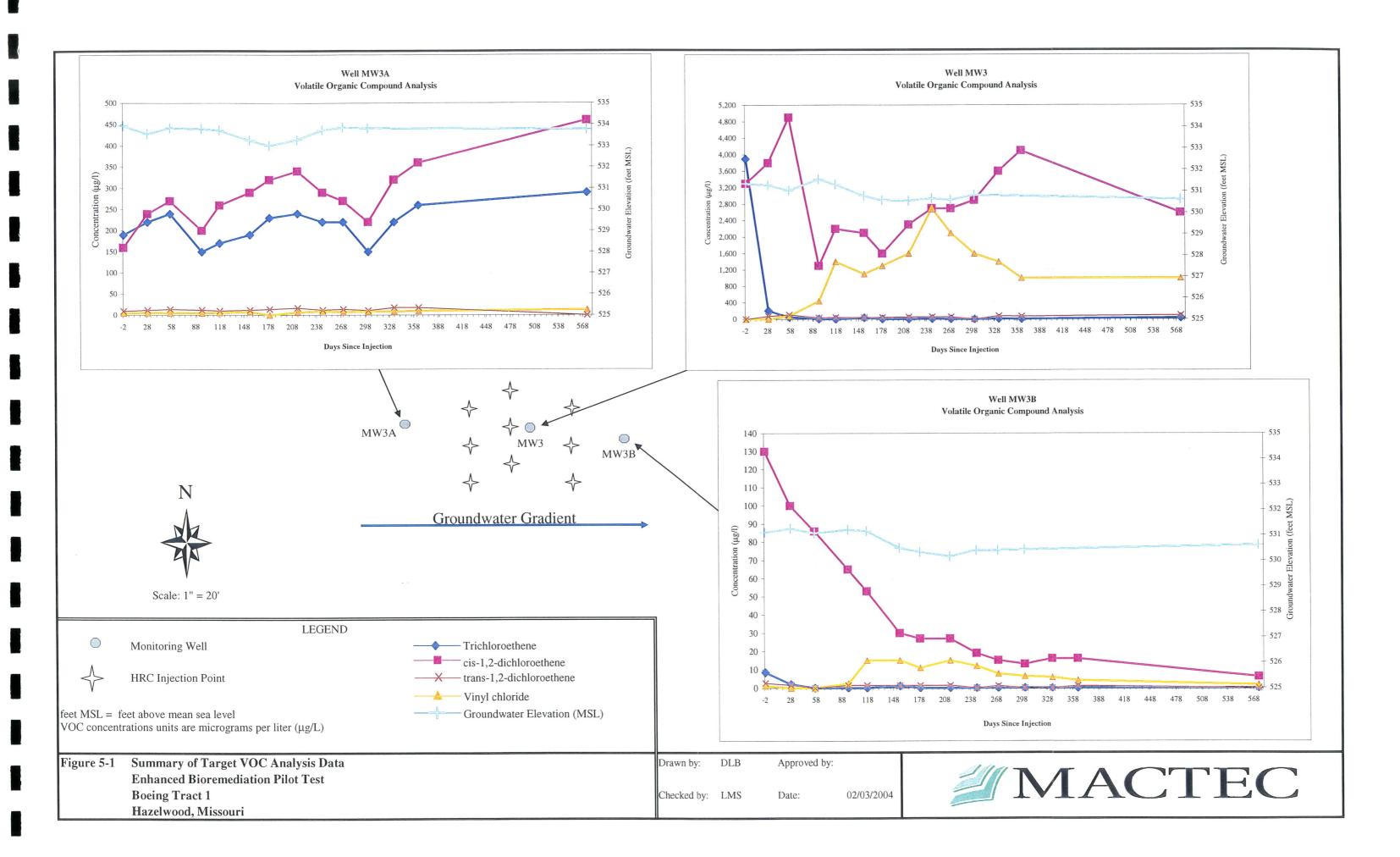


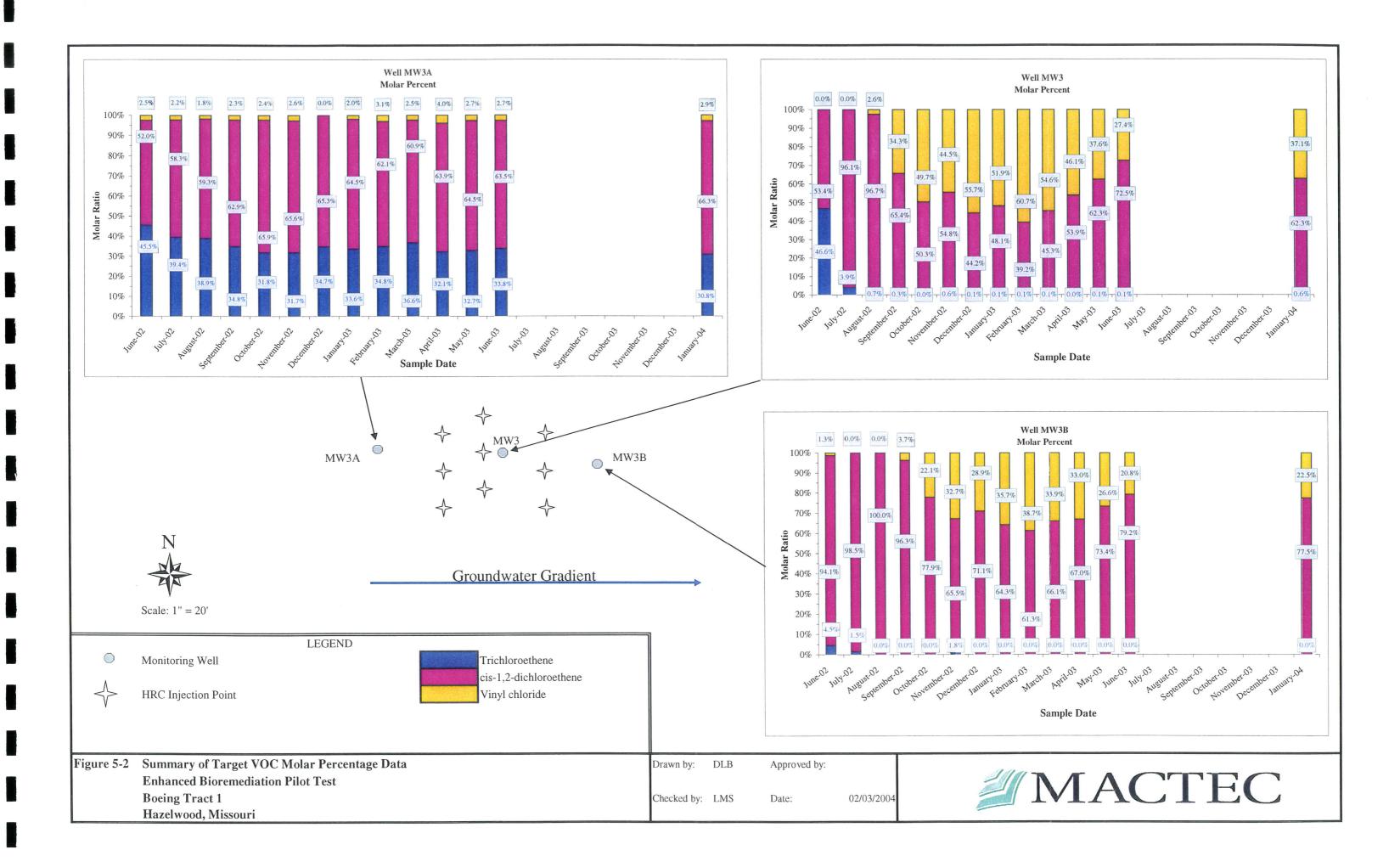
Figure 4-1 Summary of Pre-Pilot Test Target VOC Analysis from MW3
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

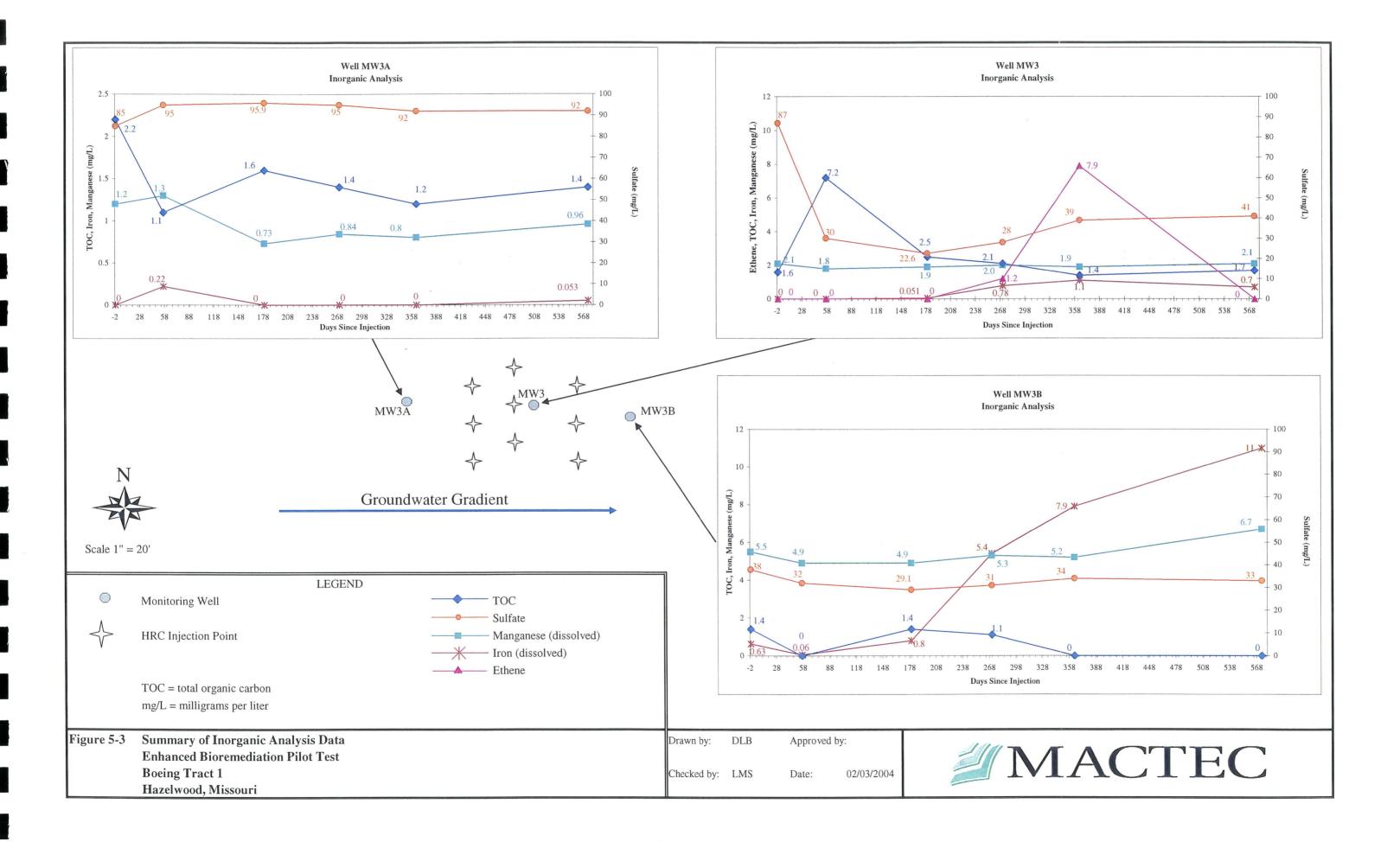
Drawn by: DLB
Checked by: LMS
Approved by:
Date: 2/4/2004

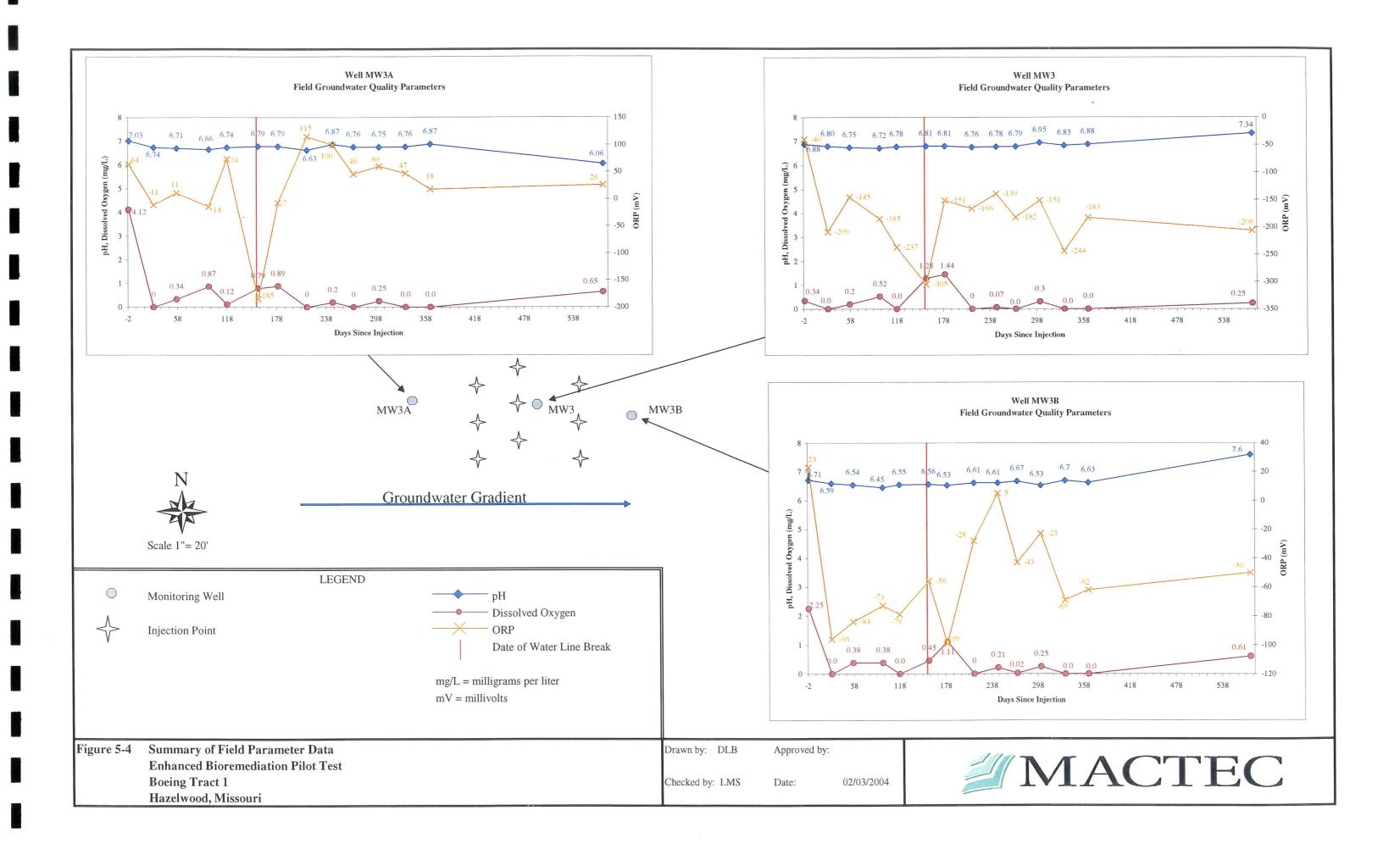












# Appendix A

**Boring and Monitoring Well Logs** 

Jan	<b>Т</b> Л							Client: Boeing	Location:	Tract 1 North	Boring # MW3
	IVIA	CTI			Well Lo	g		Logged By:	D. Brinkley		Project # 510098
Field	Locati	ion:						Drilled By:	Roberts Env	ironmental	Date:
								Drilling Method:	Hollow Stem	Auger	07/19/2000
	*							Sampling Method:	5' CME Conf	tinuous	Sheet:
	4							Hole Diameter:	8.5 inch		1 of 1
		по	ery	Analy	ses/Tests			Well Construction:	2" sch 40 P\	/C, 0.001" slot	screen
	D D	ocati	ecov	,		1	loqu	Screen Interval:	19.7	to 9.	7
h (ft)	Graphic Log	Sampler Location	Sample Recovery	<u>-</u>	Lab Sample ID		USCS Symbol	Sand Pack:	19.7	to 7.5	5
Depth (ft)	Grap	Sam	Samı	PID (ppm)	Lab (	Time	USC	Seal:	8 ft.	to 2 f	t.
		\ /							2" asphalt, 8" c		
		$  \setminus    $						rock b	ase below concr	ete.	
-		$ \setminus $		3	MW-3-2			oilty ol	av madarata nic	atiaity arayiah	
-		\/			10100-3-2		cl		ay, moderate pla soft, slightly mois		-
	1	······									
_		$  / \setminus  $									
		I/ \I	36"			1505					
5				3		1000				·	
		\ /									
		$ \setminus $				<del> </del>					
_							cl	Silty c	ay, high plasticit	ty, ducky yellov	vish
		W		2					, soft, some iron		
		$  / \setminus  $	36"								
		// N									
10				5		1515				<del></del>	
-		\ /					cl	Silty o	lay, grayish olive	e, moderate to t	niah
		***************************************		4					ity, moist, stiff, r		
<b></b>		$ \ \  $									
<u></u>											
		$  \ / \  $									
		/ \	60"								
15		/ \				1530					
			<b>,</b>			1000					
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-		$ \setminus / $		5					······································		
		V							<u> </u>		
-		/\					cl	as abo	ove, very stiff, we	et	
		/    \		2							
20		<b>/</b> \	60"			1540					

S

MACTEC			Wall La	~	-	Client:	Boeing	Location:	Tract 1 North	Boring # MW3A		
	1017.			T I	Well Lo	9		Logged	Ву:	D. Brinkley		Project # 510098
Field	Locat	ion:				-		Drilled E	Ву:	Roberts En	vironmental	Date:
								Drilling I	Method:	Hollow Ster	n Auger	06/10/2003
	A							Samplin	g Method:	5' CME Cor	ntinuous	Sheet:
	7							Hole Dia	ameter:	8.5 inch		1 of 1
		ion	ery	Analy	ses/Tests			Well Co	nstruction:	2" sch 40 P	VC, 0.001" slot	screen
	ĝo:	Sampler Location	Sample Recovery		e e	1	USCS Symbol	Screen	Interval:	20 ft.	to 5	ft.
Depth (ft)	Graphic Log	pler L	ple R		Lab Sample ID		SSyl	Sand Pa	ack:	20.5 ft.	to 3	ft.
Dept	Grap	Sam	Sam	PID (ppm)	Lab (	Time	nsc	Seal:		3 ft.	to 1	ft.
		\ /			144	0840		Descript	tion: 8	3" concrete pav		
		$  \setminus  $										
				1		<u> </u>			Silty c	lay, moderate p	lasticity gravisl	n olive
		l Å					cl			lightly moist, no		
		$1/\lambda$					]			oot scars		
		$V \setminus$				ļ						
			36"	5								
5		$\setminus$ /							As abo	ove, becoming r	noist to wet, du	sky
		$  \setminus /$					]			rish brown, mod		
		$  \ \ \  $		4					some	iron staining, no	odor	
		Ä										
		<b>*************************************</b>										
		/ \							<u> </u>			
		/ \	48"	0		0855		<u> </u>				
			70		<u> </u>		cl	<u> </u>	Color	change at 10' to	gravish olive, i	moderate
10		\ /		1						n plasticity, three		
_		$  \setminus /  $								al at 9' to 10', iro	n oxidized insid	le but
		V					:		open ı	up to 0.25"		
		***************************************										
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15		$  \setminus /  $		1								
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		/ \		1								
			60"			0910			as abo			
20			6"	1					as ab(	7ve		

Z

200	ΝΛΔ	CTI	EC.		Wall La	~		Client: Boeing	Location:	Tract 1 North	Boring # MW3B
	1417.7		عات		Well Lo	9		Logged By:	D. Brinkley	_	Project # 510098
Field	Locat	ion:						Drilled By:	Roberts En	vironmental	Date:
								Drilling Method:	Hollow Ster	n Auger	06/10/2003
	M							Sampling Method:	5' CME Cor	ntinuous	Sheet:
	<b>V</b> -							Hole Diameter:	8.5 inch	<del>"</del>	1 of 1
		ion	ery	Analy	ses/Tests			Well Construction:	2" sch 40 P	VC, 0.001" slot	screen
	Бo.	Sampler Location	Sample Recovery		ole		USCS Symbol	Screen Interval:	20 ft.	to 5 f	t.
Depth (ft)	Graphic Log	pler l	ple R	<u> </u>	Lab Sample ID		SSyl	Sand Pack:	20 ft.	to 3 f	t.
Dept	Grap	Sam	Sam	PID (ppm)	Lab (	Time	nsc	Seal:	3 ft.	to 1 f	I.
		\ /						4 <u></u>		concrete pave	
<b>-</b>		**************************************					1				
		∣V			*******			silty cla	ay/clayey silt, m	noderate plastici	ty, grayish
		$  \  \wedge \   $					cl/ml			dation, soft, moi	<u> </u>
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		V					1				
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			60"				1				
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		······						core, r	nost extend ver	tically 3-4" up to	1/8 <b>"</b> dia.
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# Appendix B

**Underground Injection Control Permit** 

#### STATE OF MISSOURI

### DEPARTMENT OF NATURAL RESOURCES

#### MISSOURI CLEAN WATER COMMISSION



# MISSOURI STATE OPERATING PERMIT

UNDERGROUND INJECTION CONTROL

-			
Pern	<b>11</b> t	N)	Λ

UI-0000020

Owner:

Boeing Company

Address:

PO Box 516, St. Louis, MO 63166

Continuing Authority:

Same as above

Address:

Same as above

Facility Name:

Boeing Fabrication Facility (Former)

Facility Address:

142 J.S. McDonnell Blvd., Hazelwood, MO 63042

Legal Description:

NW ¼, NW ¼, Sec. 5, T46N, R6E, St. Louis

Receiving Stream:

Unnamed Tributary to Coldwater Creek (U)

First Classified Stream and ID:

Coldwater Creek (C) (01706)

USGS Basin & Sub-watershed No.:

(10300200-180002)

#### **FACILITY DESCRIPTION**

Underground Injection - SIC #7389

Direct push borings to inject about 5,000 pounds of Hydrogen Release Compound, which is a lactic acid producing mixture, to a depth of about 30 feet to remediate chlorinated solvents that are present in the subsurface.

April 19, 2002 Effective Date

Stephen M. Manford, Director Department of Natural Resources
Executive Secretar, Clean Water Commission

April 18, 2007

Expiration Date MO 780-0041 (10-93) Interim Director of Staff, Clean Water Commission

#### A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

PAGE NUMBER 2 of 6

PERMIT NUMBER UI-0000020

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The final effluent limitations shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited and monitored by the permittee as specified below:

		FINAL EFF	LUENT LIM	ITATIONS				
OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT SAMPLE FREQUENCY TYPE			
Preproject Monitoring								
pH - Units	SU	**		**	once before grab project begins			
Trichloroethylene (TCE)	mg/L	*		*	once before grab project begins			
Postproject Monitoring				, ,				
pH - Units	su	**		**	once after grab projects completed			
Trichloroethylene (TCE)	mg/L	*		*	once after grab projects completed			
Lactic Acid	mg/L	*			once after grab projects completed			
Total Pounds Chemical Injected	lbs				once after report projects completed			

MONITORING REPORTS SHALL BE SUBMITTED as outlined above; THE FIRST REPORT IS DUE as outlined above. THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

#### **B. STANDARD CONDITIONS**

IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Part I STANDARD CONDITIONS DATED October 1, 1980, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.

#### A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

- \* Monitoring requirement only.
- \*\* pH is measured in pH units and is not to be averaged. The pH is limited to the range of  $6.0-9.0~\mathrm{pH}$  units.

#### C. SPECIAL CONDITIONS

 This permit does not allow for the surface discharge of any water. If permittee desires to discharge water to the surface, an NPDES State Operating Permit must first be obtained.

#### STANDARD CONDITIONS FOR UNDERGROUND INJECTION CONTROL PERMIT

#### GENERAL CONDITIONS

#### SECTION A - MONITORING AND REPORTING

#### 1. Representative Sampling

- a. Samples and measurements taken as required herein shall be representative of the nature and volume.
- b. Monitoring results shall be recorded and reported, postmarked no later than the 28<sup>th</sup> day of the month following the completed reporting period. Signed copies of these, and all other reports required herein, shall be submitted to the appropriate regional office and the Division of Geology and Land Survey, P.O. Box 250, Rolla, Missouri 65401.

#### 2. Definitions

Definitions as set forth in the Missouri Clean Water Law and Missouri Clean Water Commission Definition Regulation 10 CSR 20-2.010 shall apply to terms used herein.

#### 3. Test Procedures

Test procedures for the analysis of pollutants shall be in accordance with the Missouri Clean Water Commission Effluent Regulation 10 CSR 20-7.015.

#### 4. Recording of Results

- a. For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:
  - i. The date, exact place, and time of sampling or measurements;
  - ii. The individual(s) who performed the sampling or measurements;
  - iii.The date(s) analyses were performed;
  - iv. The individual(s) who performed the analyses;
  - v. The analytical techniques or methods used; and
  - vi. The results of such analyses.
- b. The Federal Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than 6 months per violation, or both.
- c. Calculations of all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

#### 5. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Monitoring Report Form. Such increased frequency shall also be indicated.

#### 6. Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time.

Page 4 of 6

#### SECTION B - MANAGEMENT REQUIREMENTS

#### 1. Noncompliance Notification

- a. If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum limitation specified in this permit, the permittee shall provide the Department with the following information, in writing within five (5) days of becoming aware of such condition:
  - i. A description of the violation and cause of noncompliance, and
  - ii. The period of noncompliance, including exact dates and times or, if not corrected, that anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncompliance.
- b. Twenty-four hour reporting. The permittee shall report any noncompliance, which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

#### 2. Facilities Operation

Permittees shall operate and maintain facilities to comply with the Missouri Clean Water Law and applicable permit conditions.

#### 3. Adverse Impact

The permittee shall take all necessary steps to minimize any adverse impact to waters of the state resulting from noncompliance with any limitations specified in this permit or set forth in the Missouri Clean Water Law and Regulations (hereinafter the Law and Regulations), including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

#### 4. Removed Substances

Solids, sludge, filter backwash, or other pollutants removed in the course of treatment or control of waters shall be disposed of in a manner such as to prevent any pollutants from entering waters of the state unless permitted by the Law, and a permanent record of the date and time, volume and methods of removal and disposal of such substances shall be maintained by the permittee.

#### 5. Right of Entry

For the purpose of inspecting, monitoring, or sampling the injection wells, point source, water contaminant source, or wastewater treatment facility for compliance with the Clean Water Law and these regulations, authorized representatives of the Department shall be allowed by the permittee, upon presentation of credentials and at reasonable times:

- a. to enter upon permittee's premises in which an injection well, point source, water contaminant source, or wastewater treatment facility is located or in which any records are required to be kept under terms and conditions of the permit;
- to have access to, or copy any records required to be kept under terms and conditions of the permit;
- c. to inspect any monitoring equipment or method required in the permit;
- d. to inspect any collection, treatment, or discharge facility covered under the permit; and
- e. to sample any wastewater at any point in the collection system or treatment process.

#### SECTION B - MANAGEMENT REQUIREMENTS (continued)

#### 6. Permits Transferable

- a. Subject to section (3) of 10 CSR 20-6.010 an operating permit may be transferred upon submission to the Department of an application to transfer signed by a new owner. Until such time as the permit is officially transferred, the original permittee remains responsible for complying with the terms and conditions of the existing permit.
- b. The Department, within thirty (30) days of receipt of the application shall notify the new permittee of its intent to revoke and reissue or transfer the permit.

#### 7. Availability of Reports

Except for data determined to be confidential under the Missouri Clean Water Commission Regulation for Public Participation, Hearings and Notice to Governmental Agencies 10 CSR 20-6.020, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. As required by statute, operating data shall be subject to the imposition of criminal penalties as provided for in Section 644.076 of the Law.

#### 8. Permit Modifications

- a. Subject to compliance with statutory requirements of the Law and Regulations and applicable Court Order, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:
  - i. violation of any terms or conditions of this permit or the Law;
  - ii. having obtained this permit by misrepresentation or failure to disclose fully all relevant facts;
  - iii. a change in any circumstances or conditions that requires either a temporary or permanent reduction or elimination of the authorized discharge, or
  - iv. any reason set forth in the Law and Regulations.

#### 9. Civil and Criminal Liability

Except as authorized by statute nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

#### 10. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state statute or regulations.

#### 11. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of or violation of federal, state or local laws or regulations.

#### 12. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for a new permit 180 days prior to expiration of this permit.

#### SECTION B - MANAGEMENT REQUIREMENTS (continued)

#### 13. Signatory Requirement

All reports or information submitted to the Director shall be signed.

#### 14. Rights Not Affected

Nothing in this permit shall affect the permittee's right to appeal or seek a variance from applicable laws or regulations as allowed by law.

#### 15. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

# Appendix C

**Analytical Laboratory Reports and Chain-of-Custody Forms** 





## ANALYTICAL REPORT

November 19, 2001

Page 1 of 1

Work Order: 11J1098

Work Order Information

Date Received: 10/26/2001 11:05AM

Collector:

Collector Phone: 314-567-4600

PO Number:

Report To

Doug Marian Harding ESE 3199 River Port Tech Center St. Louis, MO 63043

Project:

Boeing/GKN

Project Number: Boeing

Qualifier Analyte Result MRL Method Analyst Analyzed Matrix: Water Collected: 10/25/01 15:55 11J1098-01 MW3W

Lactic Acid (C3)

<1.0 mg/l

1.0

HPLC/UV

**FIZ** 11/16/01 9:47

End of Report

Keystone Laboratories, Inc.

richa Weinh

Ericka Weintz Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



Engineering, Inc.

11665 Lilburn Park Road, St. Louis, MO 63146-3535 Telephone: (314) 567-4600 -- Fax: (314) 567-5030

FOR LAB USE ONLY

Project Number: .

1151098 0078

**Chain of Custody Record** 

Client: HAM	DING	Est I an V	2	TE	HC	ENTOS	Sample 1. Wa	ter	Conta P - Pla	istic	pe:					And	ılys	es		
Phone #: (3/4) 2 P.O. #: Client Contact: Project # / Location	Done	700 F	がら ax#: (	65 314) 2	045		3. Sluct 4. Oil 5. Tissu Other Presert 1. Non	dge :				Y /					/ /		\ \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	Comments
Sample I.D. (10 Characters ONLY)	Sample Type	Co Size	ontainer Type	No.	Samp Date	ling Time	Preser- vative	Lab I.D.		7/		/ /	//			/ /	//2	X 6		Comments
MW3W	1	40 ml	6	2	10/25/01	1555	NONE		义							0	/			NON PRESERVE
			<u>.</u>			<u> </u>						-						<u> </u>		
						<del></del>						-						<u> </u>		
			~																	
			<u> </u>																	
Relinquished By:  Relinquished By:		Date:/0 Time: /	7 2		Receive	ed By:	b By:	Time	e: e: <b>/O</b> -2	: 26	<b>\(\)</b>		ampl	es Re	celv	ON ed Ch	llled			°C
		Time:	1			KU	2	Time	<b>∋</b> :	:05	5			J 100	· [					

SPECIAL INSTRUCTIONS: PRESENCE ASAP.

Copies: White - Client Canary - Lab Receiving Pink - Lab File Goldenrod - Retained by Sampler



RECEIVED SEP 27 2002



Date Received: 06/20/2002 10:00AM

Collector: Friesner, Jack Phone: 314-567-4600



Accreditations: Iowa DNR: 095 New Jersey DEP: IA001 Kansas DHE: E-10287

# ANALYTICAL REPORT

Work Order Information

PO Number:

September 25, 2002

Page 1 of 2

Work Order: 12F0702

Report To

Dennis Brinkley Harding ESE - MO

3199 River Port Tech Center

St. Louis, MO 63043

Analyte		Result	MRL	Method	Analyst	Analyzed	Qualifier
12F0702-01	MW3W			Matrix:Water		Collected: 06/19	0/02 08:30
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH	06/26/02 23:2	4
Lactic Acid (C3)		26.6 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:2	
Lactic Acid (C3)		26.6 mg/l	1.0	HPLC/UV	GGD	06/26/02 23:2	
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:2	
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:2	
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:2	24
12F0702-02	MW3AW			Matrix:Water		Collected: 06/19	9/02 17:45
		.0.4 #			** **	06/06/00 00	15
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH	06/26/02 23:4	
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:4	
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	GGD	06/26/02 23:4	
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:4	
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:4	
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:4	ł5 
12F0702-03	MW3BW			Matrix:Water		Collected: 06/1	9/02 15:90
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH	06/27/02 0:0	6
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	GGD	06/27/02 0:0	
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:0	
Acetic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:0	
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:0	-
1 Topionic Acia (C3)		-1.0 mg/1	1.0	HPLC/UV	3111	0.012/1/02 0.0	•

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

1.0

HPLC/UV

<1.0 mg/l

06/27/02 0:06

JLH

Butyric Acid (C4)







Harding ESE - MO 3199 River Port Tech Center St. Louis, MO 63043

Work Order: 12F0702

**September 25, 2002** 

Page 2 of 2

End of Report

Ericka Weintz Project Manager

Keystone Laboratories, Inc.

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted.  $MRL=Method\ Reporting\ Limit.$ 

# CHAIN OF CUSICUY RECURD



600 E. 17<sup>th</sup> St. S. Newton, IA 50208 Phone: 641-792-8451

3012 Ansborough Ave. Waterloo, IA 50701

Phone: 319-235-4440

1304 Adams

Kansas City, KS 66103 Phone: 913-321-7856

PAGE\_ OF\_

PRINT OR TYPE INFORMATION BELOW  SAMPLER: JACK E FRIESNER  SITE NAME: BOEING/GCKN  ADDRESS:  CITY/ST/ZIP: ST LOUIS MO  PHONE:	REPORT TO:  NAME: DENNIS BRINCLEY  COMPANY NAME: HARDING USE  ADDRESS: 3199 RIVERPORT Tech Center Dr.  CITY/ST/ZIP: MARYLAND HENCHTSMO 6318  PHONE: (314) 209-5900  FAX: (314) 209-5927	BILL TO:  NAME:  COMPANY NAME: HARDING ESE  ADDRESS:  CITY/ST/ZIP:  PHONE:  Keystone Quote No.:  (If Applicable)
	OMPOSITE DUC ACIDS	

				1 40									LAD OOL (	JI42 !
				1 22			.2		-			li	LABORATORY WORK ORDER N	0.
				CONTAINERS		GRAB/COMPOSITE	Acids						12 - 670	2
				NO.		)MP(	METHBOUC						SAMPLE TEMPERATURE UPON RECEIPT:	LABORATORY
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CLIENT	DATE	TIME		l	MATRIX	🛣	<u>5</u>							NUMBER
SAMPLE NUMBER	👌	Ê	SAMPLE LOCATION	9	È	ū	IJ						SAMPLE CONDITION/COMMENTS	
MW3W	6/19/02	0836		1	GW		X							01
		1745		1	GW		X				$\perp$			Q2
	6/18/02	1500		J	GW		X					ļ		03
L	<u> </u>		<u> </u>		<u> </u>			·				 		

			L				
Relinquished by: (Signature)	Date 6/19/02	Received by: (Signature)	Date		Turn-Around: Standard	Rush	
Xh Ex-	Time 17-30		Time	1	Standard	- rusii _	Contact Lab Prior to Submission
Relinguished by: (Signature)	Date	Received for Lab by: (Signature)	Date /20	0/02	Remarks:		
	Time	KiD	Time	60			
Law Law III a la		Original - Return with Report • Ye	ellow - Lab Co	ру •	Pink - Sampler Copy		FORM: CCR 7-







Accreditations: lowa DNR: 095 New Jersey DEP: IA001 Kansas DHE: E-10287

# **ANALYTICAL REPORT**

October 10, 2002

Work Order: 12I0812

Page 1 of 3

### Report To

Dennis Brinkley Harding ESE - MO 3199 River Port Tech Center St. Louis, MO 63043

Project : Boeing/GKN Project Number: Boeing

### **Work Order Information**

Date Received: 09/24/2002 10:40AM Collector:

Phone: 314-567-4600

PO Number:

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
12I0812-01 MW3A				Matrix:Water	•	Collected: 09/23/0	2 07:15
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Lactic Acid (C3)	$<1.0 \mathrm{mg/l}$	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Acetic Acid (C2)	<1.0 mg/1	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Propionic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
Butyric Acid (C4)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
<b>12I0812-02</b> MW3				Matrix:Water	•	Collected: 09/23/0	2 08:20
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Lactic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Acetic Acid (C2)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Propionic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
Butyric Acid (C4)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
12I0812-03 MW3B				Matrix:Water	(	Collected: 09/19/0	2 14:40
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Lactic Acid (C3)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Acetic Acid (C2)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Propionic Acid (C3)	$<1.0\mathrm{mg/l}$	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
Butyric Acid (C4)	<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.







Harding ESE - MO 3199 River Port Tech Center St. Louis, MO 63043

Work Order: 12I0812

October 10, 2002 Page 2 of 3

RPD

%REC

## Determination of Metabolic Acids - Quality Control Keystone Laboratories, Inc. - Newton

Spike

Source

Reporting

Analyte	Result	Limit	Units	Level	Result	%REC	Limits	RPD	Limit	Notes
Batch 1J20820 - General Prep HPLC	лс									
Blank (1J20820-BLK1)				Prepared	& Analyz	ed: 10/07/	02			
Pyruvic Acid (C3)	ND	0.1	mg/l	*						
Lactic Acid (C3)	ND	1.0	**							
Acetic Acid (C2)	ND	1.0	**							
Propionic Acid (C3)	ND	1.0	#1							
Butyric Acid (C4)	ND	1.0	**							
LCS (1J20820-BS1)				Prepared	& Analyz	ed: 10/07/	02			
Pyruvic Acid (C3)	55.00	0.1	mg/l	56.70		97.0	66-134			
Lactic Acid (C3)	237.3	. 1.0	*	198.9		119	68-138			
Acetic Acid (C2)	149.7	1.0	**	150.8		99.3	73-122			
Propionic Acid (C3)	156.7	1.0	ti .	156.0		100	77-120			
Butyric Acid (C4)	146.7	1.0	"	146.4		100	75-119			
Matrix Spike (1J20820-MS1)	S	ource: 12I081	4-01	Prepared	& Analyz	ed: 10/07/	02			
Pyruvic Acid (C3)	46.34	0.1	mg/l	37.80	ND	123	58-127			
Lactic Acid (C3)	182.5	1.0	**	132.6	ND	138	58-132		•	QM-05
Acetic Acid (C2)	117.3	1.0	"	100.6	ND	117	65-128			
Propionic Acid (C3)	133.3	1.0	"	104.0	ND	128	64-128			
Butyric Acid (C4)	108.6	1.0	**	97.60	ND	111	67-127			
Matrix Spike Dup (1J20820-MSD1)	S	ource: 12I081	4-01	Prepared	& Analyz	ed: 10/07/	02			
Pyruvic Acid (C3)	45.87	0.1	mg/l	37.80	ND	121	58-127	1.02	28	
Lactic Acid (C3)	185.9	1.0	٠.	132.6	ND	140	58-132	1.85	29	QM-03
Acetic Acid (C2)	120.5	1.0	н .	100.6	ND	120	65-128	2.69	31	
Propionic Acid (C3)	134.6	1.0	**	104.0	ND	129	64-128	0.971	28	QM-05

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference

113.2

#### **Notes and Definitions**

QM-05 The spike recovery was outside acceptance limits for the MS and/or MSD due to matrix interference. The LCS and/or LCSD were within acceptance limits showing that the laboratory is in control and the data is acceptable.

1.0

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97.60

116

67-127

4.15

26

Butyric Acid (C4)







Harding ESE - MO 3199 River Port Tech Center St. Louis, MO 63043

Work Order: 12I0812

October 10, 2002

Page 3 of 3

End of Report

Project Manager

Ericka Weintz

Keystone Laboratories, Inc.

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.



Telephone: (314) 567-4600 Fax: (314) 567-5030

# FOR LAB USE ONLY Project Number: \_

# **Chain of Custody Record**

Client: HARDING ESE  Address: 3199 RIVERPORT TECH CEUTER  St. Louis Mo 63043  Phone #: (311) 209 - 5900 Fax #: (314) 209 - 592  P.O. #:  Client Contact: DEUNIS BRINKLEY 1991  Project # / Location: BORING/GKN	1. Water 2. Soll 3. Sludge 4. Oil 5. Tissue	Container Type: P - Plastic G - Glass V - VOC	Analyses  Analyses  Analyses  Analyses  Comments
Sample I.D. Sample Container Sampling (10 Characters ONLY) Type Size Type No. Date T	Preser- vative Lab I.C		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
MW3A 1 80ml Amb 1 9/23/02 0 MW3B 1 80ml Amb 1 9/19/02 14	20 6	X X X	02 03
Relinquished By:  Date: 9-23 OZ Received  Time: 10 00  Date: 9-23 OZ Received  Time: 125:	Tim For Lab By: Do	me: :: me: /0:40	FOR LAB USE ONLY Samples Received Chilled  Yes No

SPECIAL INSTRUCTIONS:







Accreditations: lowa DNR: 095 New Jersey DEP: IA001 Kansas DHE: E-10287

### ANALYTICAL REPORT

January 08, 2003

Work Order: 12L0584

Page 1 of 1

Report To

Dennis Brinkley

MACTEC (Harding ESE) 3199 River Port Tech Center

St. Louis, MO 63043

Project: Boeing/GKN Project Number: Boeing/GKN

#### **Work Order Information**

Date Received: 12/17/2002 10:04AM

Collector: Friesner, Jack Phone: 314-567-4600

PO Number:

Analyte		Result	MRL	Method	Analyst Analyzed Qualifier
12L0584-01	MW3BW			Matrix:Water	Collected: 12/16/02 13:55
Pyruvic Acid (C3)		<0.2 mg/l	0.2	HPLC/UV	JLH 01/07/03 10:20 R-01
Lactic Acid (C3)		<2.0 mg/l	2.0	HPLC/UV	JLH 01/07/03 10:20 R-01
Acetic Acid (C2)		<2.0 mg/l	2.0	HPLC/UV	JLH 01/07/03 10:20 R-01
Propionic Acid (C3)		<2.0 mg/l	2.0	HPLC/UV	JLH 01/07/03 10:20 R-01
Butyric Acid (C4)		<2.0 mg/l	2.0	HPLC/UV	JLH 01/07/03 10:20 R-01
12L0584-02	MW3W			Matrix:Water	Collected: 12/16/02 15:05
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH 01/06/03 15:12
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH 01/06/03 15:12
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH 01/06/03 15:12
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH 01/06/03 15:12
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH 01/06/03 15:12
12L0584-03	MW3AW			Matrix:Water	Collected: 12/16/02 16:35
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH 01/06/03 15:34
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH 01/06/03 15:34
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH 01/06/03 15:34
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH 01/06/03 15:34
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH 01/06/03 15:34

#### **Notes and Definitions**

R-01

The Reporting Limit for this analyte has been raised to account for matrix interference.

End of Report

Keystone Laboratories, Inc.

Oricka Weins

Ericka Weintz Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

### U HAIN OF UUSIODY RECURD



600 E. 17<sup>th</sup> St. S. Newton, IA 50208

Phone: 641-792-8451 Fax: 641-792-7989

3012 Ansborough Ave. Waterloo, IA 50701

Phone: 319-235-4440 Fax: 319-235-2480 ☐ 1304 Adams

Kansas City, KS 66103 Phone: 913-321-7856

Fax: 913-321-7937

PAGEOF
--------

FORM: CCR 7-97

PRINT OR TYPE INFORMATION SAMPLER: JPCC E SITE NAME: BOEING ADDRESS: CITY/ST/ZIP: PHONE:	COMPANY NAME:  ADDRESS: 3149  CITY/ST/ZIP: ST  PHONE: (314)	NAME: DEUNIS BRINCLEY COMPANY NAME: MACTEC ADDRESS: 3199 RIVERPORT TECHCENEY Dr. CITY/ST/ZIP: ST LOUIS MO 63043 PHONE: (314) 209-5900 FAX: (314) 209-5929								BILL TO:  NAME: DENNIS BRIVLLEY  COMPANY NAME: MACTEC  ADDRESS: 3199 RIVERENT TECH GENTLE DE  CITY/ST/ZIP: ST LOUIS MO 63043  PHONE: (314) 201-5900  Keystone Quote No.: (If Applicable)								
CLIENT SAMPLE NUMBER	DATE	TIME	5	SAMPLE LOCATION	NO. OF CONTAINERS	MATRIX	GRAB/COMPOSITE	MERNBOUL ALLA	ANAL	YSES	REC	UIRE	D	,	SAMPLE TEM UPON RECEI	) 2 PERATURE	R NC	
MW3BW	12/16/2	1355			<u> </u>	6w		X									_	A.
MW3W	12/16/02	1505				GW		X										02
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Relinquished by: (Signature	Received for Lab by: (Signat	eived for Lab by: (Signature) Date Rer				Remarks:												
		Time					1											

Original - Return with Report 

Yellow - Lab Copy

Pink - Sampler Copy







Accreditations: Iowa DNR: 095 New Jersey DEP: IA001 Kansas DHE: E-10287

## ANALYTICAL REPORT

March 20, 2003

Page 1 of 1

Work Order: 13C0609

Report To

Dennis Brinkley MACTEC (Harding ESE) 3199 River Port Tech Center

St. Louis, MO 63043

Project: Boeing/GKN Project Number: Boeing **Work Order Information** 

Date Received: 03/18/2003 1:22PM

Collector:

Phone: 314-567-4600

PO Number:

Analyte		Result	MRL	Method	Analys	t Analyzed Qualifier
13C0609-01	MW3BW	·		Matrix:Water	· · · · · · · · · · · · · · · · · · ·	Collected: 03/17/03 14:05
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 20:31
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:31
13C0609-02	MW3B			Matrix:Water		Collected: 03/17/03 18:15
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 20:52
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52
Propionic Acid (C3)		<1.0  mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:52
13C0609-03	MW3BAW			Matrix:Water		Collected: 03/17/03 16:30
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 21:14
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:14

End of Report

Keystone Laboratories, Inc.

Ericka Weink

Ericka Weintz Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.



11<del>665 Lilburn Park Road, St. Louis, MO 63146-353</del>5 Telephone: (314) 567-4600 -- Fax. (314) 567-5030

# FOR LAB USE ONLY Project Number: 135669

# **Chain of Custody Record**

Client: MACTEC							Sample Type: Container Type: Analyses  1. Water P - Plastic															
Address: 3199 Riverport Text (Fibre DR ST Louis MD 63043  Phone #: 614 209-5900 Fax #: (314) 209-5929  P.O. #: Client Contact: DENNIS BRINKLEY Project # / Location: 510098 Bocing 6KU  Sample I.D. Sample Container Sampling							2. Soil G - Glass 3. Sludge V - VOC 4. Oil 5. Tissue Other: Preservative: 1. None 4. NaOH 2. H2SO4 5. HCl 3. HNO3															
Sample I.D. Sample (10 Characters ONLY) Type	Size	ontainer Type	No.	Samp Date	ling Time	Preser- vative	Lab I.l	D. /	\Z	الا /	/ /	//				$\angle$			8	\ \display \ \display \dint \display \d		Comments
MW3BW 6W	•			3/17/03	1405	H <sub>3</sub> POy	ANSO	<b>70</b>														a)
MW3W GW					1815	1	PHIL	(w)	X													62
MW3AW 6W				4	1630	7			X		_											03
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Accreditations: Iowa DNR: 095 New Jersey DEP: IA001 Kansas DHE: E-10287

### ANALYTICAL REPORT

June 26, 2003

Page 1 of 3

Work Order: 13F0789

Report To

Dennis Brinkley MACTEC E & C - MO 3199 River Port Tech Center St. Louis, MO 63043

Project : Boeing/GKN Project Number: Boeing Work Order Information

Date Received: 06/19/2003 9:43AM Collector: Jack E. Friesney Phone: 314-567-4600

PO Number:

Analyte	Result	MRL	Batch	Method	Analyst Analyzed Qualifier
<b>13F0789-01</b> MW3BW				Matrix:Water	Collected: 06/18/03 12:30
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	JLH 06/24/03 14:45
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 14:45
Acetic Acid (C2)	$< 1.0 \mathrm{mg/l}$	1.0	1F32535	HPLC/UV	JLH 06/24/03 14:45
Propionic Acid (C3)	< 1.0  mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 14:45
Butyric Acid (C4)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 14:45
13F0789-02 MW3AW				Matrix:Water	Collected: 06/18/03 15:10
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	JLH 06/24/03 15:07
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:07
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:07
Propionic Acid (C3)	< 1.0  mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:07
Butyric Acid (C4)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:07
<b>13F0789-03</b> MW3W		-		Matrix:Water	Collected: 06/18/03 16:30
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	JLH 06/24/03 15:57
Lactic Acid (C3)	$< 1.0 \mathrm{mg/l}$	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:57
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:57
Propionic Acid (C3)	<1.0 mg/l	. 1.0	1F32535	HPLC/UV	JLH 06/24/03 15:57
Butyric Acid (C4)	<1.0 mg/l	i.û	1F32535	HPLC/UV	JLH 06/24/03 15:57

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.







MACTEC E & C - MO 3199 River Port Tech Center St. Louis, MO 63043

Work Order: 13F0789

June 26, 2003 Page 2 of 3

**RPD** 

## **Determination of Metabolic Acids - Quality Control Keystone Laboratories, Inc. - Newton**

Spike

Source

%REC

Reporting

Analyte	Result	Limit	Units	Level	Result	%REC	Limits	RPD	Limit	Notes
Batch 1F32535 - General Prep HPLO	C/IC				·				,	
Blank (1F32535-BLK1)				Prepared	& Analyzo	ed: 06/24/	03			
Pyruvio Acid (C3)	ND	0.1	mg/l			<del></del>				
Lactic Acid (C3)	ND	1.0	**							
Acetic Acid (C2)	ND	1.0	H							
Propionic Acid (C3)	ND	1.0	11							
Butyric Acid (C4)	ND	1.0	**							
LCS (1F32535-BS1)				Prepared	& Analyzo	ed: 06/24/	03			
Pyruvic Acid (C3)	36.60	0.1	mg/l	36.75	· · · · · · · · · · · · · · · · · · ·	99.6	81-136			
Lactic Acid (C3)	180.4	1.0	**	203.7		88.6	64-134			
Acetic Acid (C2)	166.6	1.0	**	150.7		111	82-122			
Propionic Acid (C3)	169.0	1.0		162.4		104	90-112			
Butyric Acid (C4)	155.0	1.0	"	152.4		102	88-113			
Calibration Check (1F32535-CCV1)				Prepared	& Analyze	ed: 06/24/	03			
Pyruvic Acid (C3)	29.34	0.1	mg/l	28.00		105	80-120			
Lactic Acid (C3)	94.35	1.0		98.94		95.4	80-120			
Acetic Acid (C2)	103.1	1.0		91.68		112	80-120			
Propionic Acid (C3)	102.3	1.0		94.60		108	80-120			
Butyric Acid (C4)	123.7	1.0	**	114.2		108	80-120			
Calibration Check (1F32535-CCV2)				Prepared	& Analyze	ed: 06/24/0	03			
Pyruvic Acid (C3)	29.42	0.1	mg/l	28.00		105	80-120			
Lactic Acid (C3)	96.81	1.0	"	98.94		97.8	80-120			
Acetic Acid (C2)	97.84	1.0	"	91.68		107	80-120			
Propionic Acid (C3)	99.95	1.0	**	94.60		106	80-120			
Butyric Acid (C4)	115.5	1.0	**	114.2		101	80-120			
Matrix Spike (1F32535-MS1)	S	ource: 13F093	3-01	Prepared	& Analyze	ed: 06/24/0	03			
Pyruvic Acid (C3)	26.45	0.1	mg/l	24.50	ND	108	85-149			
Lactic Acid (C3)	129.2	1.0	н	135.8	ND	95.1	61-140			
Acetic Acid (C2)	116.3	1.0	"	100.5	ND	116	68-145			
Propionic Acid (C3)	117.2	1.0	**	108.3	ND	108	76-140			
Butyric Acid (C4)	110.1	1.0		101.6	ND	108	79-132			

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.







MACTEC E & C - MO 3199 River Port Tech Center St. Louis, MO 63043

Work Order: 13F0789

June 26, 2003 Page 3 of 3

## Determination of Metabolic Acids - Quality Control Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1F32535 - General Prep HPLC	СЛС									
Matrix Spike Dup (1F32535-MSD1)	So	urce: 13F093	3-01	Prepared	& Analyze	ed: 06/24/	03			
Pyruvic Acid (C3)	26.10	9.1	mg/l	24.50	ND	107	85-149	1.33	15	
Lactic Acid (C3)	130.5	1.0	"	135.8	ND	96.1	61-140	1.00	10	
Acetic Acid (C2)	116.6	1.0	"	100.5	ND	116	68-145	0.258	23	
Propionic Acid (C3)	121.5	1.0		108.3	ND	112	76-140	3.60	12	
Butyric Acid (C4)	110.7	1.0	**	101.6	ND	109	79-132	0.543	21	

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference

End of Report

Keystone Laboratories, Inc.

Jeffrey King, Ph.D. Laboratory Director

### CHAIN OF CUSTONY KELJEN

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L	. A B O R A T	ORIES.	INC.

600 E. 17<sup>th</sup> St. S. Newton, IA 50208 Phone: 641-792-8451

Fax: 641-792-7989

Waterloo, IA 50701 Phone: 319-235-4440 Fax: 319-235-2480

3012 Ansborough Ave.

1304 Adams

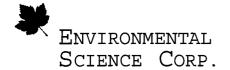
Kansas City, KS 66103 Phone: 913-321-7856 Fax: 913-321-7937

PAGE	_of	

FORM: CCR 7-97

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PRINT OR TYPE INFORMATION	BELOW				NAME: DE WILLEY								BILL TO:						
SAMPLER: JACK E	_																		
SITE NAME: BOOK NO	GHN				COMPANY NAME: ADDRESS: 3190.	$\sum_{i=1}^{n}$	23~27	<u> </u>		<u></u>	enes y	- v2	COMPANY NAME:						
ADDRESS:					CITY/ST/ZIP: ST		XTUCI		SCAL W	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	ンケメ	<u>د ا</u>							
CITY/ST/ZIP:					DUONE (314)	2000 2009	-6791	$\sim$	<del></del>			-	CITY/ST/ZIP:						
					PHONE: (314) 209-5900 FAX: (314) 209-5929								PHONE:						
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 						CONTAINERS		GRAB/COMPOSITE	VERBOUC ALIDS		İ					13F078	'9		
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CLIENT	DATE	Ψ				Ö	MATRIX	AB/	K							°C	SAMPLE NUMBER		
SAMPLE NUMBER	DA	TIME		SAMPL	E LOCATION	N O	Σ	GR	N							SAMPLE CONDITION/COMMENTS			
MW3BW	6 18 03	1230				1	600		X								01		
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Time					Time				Standard Rush Contact Lab Prior to Submission										
Relinquished by: (Signature) Date Receive					ceived for Lab by: (Signature) Date 7-03				3	Remarks:									
Time					Time						-								

Original - Return with Report • Yellow - Lab Copy • Pink - Sampler Copy



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley

MACTEC - St. Louis, MO 3199 Riverport Tech Center Drive St. Louis, MO 63043

ESC Sample # : L141005-01

January 20, 2004

Site ID :

Date Received : Description : January 15, 2004

Description

GW - Boeing

Sample ID

MW3AW

Collected By : Jack E Friesner Collection Date : 01/14/04 14:15

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Methane	BDL	1.0	ppm	8015M	01/15/04	1
Chloride	690	5.0	mg/l	9056	01/16/04	5
Nitrate	BDL	0.10	mg/l	9056	01/16/04	1
Nitrite	BDL	0.10	mg/l	9056	01/16/04	1
Sulfate	92.	5.0	mg/1	9056	01/16/04	1
Free Carbon Dioxide	180	20.	mg/l	406B	01/15/04	2
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	2.6	1.0	mg/l	5310B	01/19/04	1
Sulfide	BDL	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	1.4	1.0	mg/l	9060	01/15/04	1
Iron	BDL	0.050	mq/l	6010B	01/16/04	1
Iron,Dissolved	0.053	0.050	mg/l	6010B	01/17/04	1
Manganese, Dissolved	0.96	0.010	mg/l	6010B	01/17/04	1
Volatile Organics					,	
Acetone	BDL	0.050	mg/l	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	BDL	0.050	mg/1	8260B	01/15/04	1
Benzene	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mg/1	8260B	01/15/04	1
Bromoform	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	1
Bromomethane	$\mathtt{BDL}$	0.0010	mg/1	8260B	01/15/04	1
n-Butylbenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/1	8260B	01/15/04	1
Chlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorodibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloroethane	BDL	0.0010	mg/1	8260B	01/15/04	1

BDL - Below Detection Limit

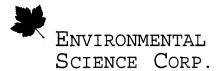
Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Page 1 of 20



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO 3199 Riverport Tech Center Drive St. Louis, MO 63043

January 20, 2004

Site ID :

ESC Sample # : L141005-01

Date Received : January 15, 2004

GW - Boeing Description

Sample ID : MW3AW

Collected By : Jack E Friesner Collection Date : 01/14/04 14:15 Jack E Friesner Project #: 3250035046

2-Chloroethyl vinyl ether Chloroform Chloromethane 2-Chlorotoluene 4-Chlorotoluene	BDL BDL BDL BDL BDL BDL BDL	0.050 0.0050 0.0010 0.0010 0.0010 0.0020	mg/1 mg/1 mg/1 mg/1 mg/1	8260B 8260B 8260B 8260B	01/15/04 01/15/04 01/15/04	1 1 1
Chloroform Chloromethane 2-Chlorotoluene 4-Chlorotoluene	BDL BDL BDL BDL	0.0010 0.0010 0.0010	mg/l mg/l mg/l	8260B	01/15/04 01/15/04	1
2-Chlorotoluene 4-Chlorotoluene	BDL BDL BDL	0.0010 0.0010	mg/l mg/l			1
4-Chlorotoluene	BDL BDL	0.0010	mg/l	8260B		
	BDL				01/15/04	1
13		0 0020	1114/1	8260B	01/15/04	1
1,2-Dibromo-3-Chloropropane	BDI.	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromoethane		0.0010	mg/l	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,4-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Dichlorodifluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethene	0.0015	0.0010	mg/l	8260B	01/15/04	1
cis-1,2-Dichloroethene	0.46	0.0010	mg/l	8260B	01/15/04	1
trans-1,2-Dichloroethene	BDL	0.0010	mg/1	8260B	01/15/04	1
1,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
trans-1,3-Dichloropropene	BDL	0.0010	mq/l	8260B	01/15/04	1
2,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
Di-isopropyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Ethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Hexachlorobutadiene	BDL	0.0010	mg/l	8260B	01/15/04	1
Isopropylbenzene	BDL	0.0010	mq/l	8260B	01/15/04	1
p-Isopropyltoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Butanone (MEK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methylene Chloride	BDL	0.0050	mg/l	8260B	01/15/04	1
4-Methyl-2-pentanone (MIBK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methyl tert-butyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Naphthalene	BDL	0.0050	mq/l	8260B	01/15/04	1
n-Propylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Styrene	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,1,1,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/l	8260B	01/15/04	1
Tetrachloroethene	BDL	0.0010	mg/l	8260B	01/15/04	ī

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO

3199 Riverport Tech Center Drive

St. Louis, MO 63043

ESC Sample # : L141005-01

Date Received : January Description

15, 2004 GW - Boeing :

Site ID :

January 20, 2004

Sample ID

MW3AW

Project #: 3250035046

Jack E Friesner Collected By Collection Date : 01/14/04 14:15

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Toluene	BDL	0.0050	mg/l	8260B	01/15/04	1
1,2,3-Trichlorobenzene	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
1,1,1-Trichloroethane	BDL	0.0010	mq/l	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	0.29	0.0010	mg/l	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
Vinyl chloride	0.013	0.0010	mg/l	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mg/l	8260B	01/15/04	1
Surrogate Recovery			-			
Toluene-d8	98.		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233 Note:

The reported analytical results relate only to the sample submitted. This report shall not be reproduced, except in full, without the written approval from ESC.

Reported: 01/20/04 09:23 Printed: 01/20/04 15:02

Representative



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO 3199 Riverport Tech Center Drive St. Louis, MO 63043

January 20, 2004

Site ID :

ESC Sample # : L141005-02

Date Received :

January 15, 2004

Description

GW - Boeing

Sample ID

Collected By : Jack E Friesner Collection Date : 01/14/04 12:35

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Methane	BDL	1.0	ppm	8015M	01/15/04	1
Chloride	1400	10.	mg/l	9056	01/16/04	10
Nitrate	BDL	0.10	mg/l	9056	01/16/04	1
Nitrite	BDL	0.10	mg/l	9056	01/16/04	1
Sulfate	33.	5.0	mg/1	9056	01/16/04	1
Free Carbon Dioxide	120	10.	mg/1	406B	01/15/04	1
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	1.4	1.0	mg/l	5310B	01/19/04	1
Sulfide	BDL	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	BDL	1.0	mg/l	9060	01/15/04	1
Iron	16.	0.050	mg/l	6010B	01/16/04	1
Iron,Dissolved	11.	0.050	mg/l	6010B	01/17/04	1
Manganese, Dissolved	6.7	0.010	mg/l	6010B	01/17/04	1
Volatile Organics						
Acetone	BDL	0.050	mg/l	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	BDL	0.050	mg/l	8260B	01/15/04	1
Benzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromoform	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromomethane	BDL	0.0010	mg/1	8260B	01/15/04	1
n-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1 1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/1	8260B	01/15/04	1
Chlorobenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
Chlorodibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloroethane	$\mathtt{BDL}$	0.0010	mg/1	8260B	01/15/04	1

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO

3199 Riverport Tech Center Drive St. Louis, MO 63043

ESC Sample # : L141005-02

Project # : 3250035046

January 20, 2004

Site ID :

Date Received : January 15, 2004

Description GW - Boeing

Sample ID MW3BW

Collected By : Jack E Friesner Collection Date : 01/14/04 12:35

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
2-Chloroethyl vinyl ether	BDL	0.050	mg/l	8260B	01/15/04	1
Chloroform	$\mathtt{BDL}$	0.0050	mq/l	8260B	01/15/04	1
Chloromethane	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	1
2-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
4-Chlorotoluene	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	1
1,2-Dibromo-3-Chloropropane	$\mathtt{BDL}$	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromoethane	$\mathtt{BDL}$	0.0010	mg/1	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,4-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Dichlorodifluoromethane	BDL	0.0010	mq/1	8260B	01/15/04	1
1,1-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,2-Dichloroethane	BDL	0.0010	mq/1	8260B	01/15/04	ī
1.1-Dichloroethene	BDL	0.0010	mg/l	8260B	01/15/04	ī
cis-1,2-Dichloroethene	0.0062	0.0010	mg/l	8260B	01/15/04	ī
trans-1,2-Dichloroethene	BDL	0.0010	mq/1	8260B	01/15/04	1
1,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloropropene	BDL	0.0010	mg/1	8260B	01/15/04	ī
1,3-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
trans-1,3-Dichloropropene	BDL	0.0010	mg/1	8260B	01/15/04	1
2,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
Di-isopropyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Ethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Hexachlorobutadiene	BDL	0.0010	mq/l	8260B	01/15/04	ī
Isopropylbenzene	BDL	0.0010	mq/1	8260B	01/15/04	1
p-Isopropyltoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Butanone (MEK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methylene Chloride	BDL	0.0050	mg/1	8260B	01/15/04	1
4-Methyl-2-pentanone (MIBK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methyl tert-butyl ether	BDL	0.0010	mg/l	8260B	01/15/04	1
Naphthalene	$\mathtt{BDL}$	0.0050	mg/l	8260B	01/15/04	1
n-Propylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Styrene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/l	8260B	01/15/04	1
Tetrachloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO

3199 Riverport Tech Center Drive

St. Louis, MO 63043

Date Received :

January 20, 2004

Site ID :

January 15, 2004

Description GW - Boeing

Sample ID MW3BW

Collected By : Jack E Friesner Collection Date : 01/14/04 12:35

ESC Sample # : L141005-02

Project #: 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Toluene	BDL	0.0050	mq/l	8260B	01/15/04	1
1,2,3-Trichlorobenzene	BDL	0.0010	mq/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1-Trichloroethane	BDL	0.0010	mq/l	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mq/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mq/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Vinyl chloride	0.0018	0.0010	mg/1	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mg/l	8260B	01/15/04	1
Surrogate Recovery			-		, ,	
Toluene-d8	100		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

The reported analytical results relate only to the sample submitted. This report shall not be reproduced, except in full, without the written approval from ESC.

Reported: 01/20/04 09:23 Printed: 01/20/04 15:02

Page 6 of 20

ESC Representative



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley

MACTEC - St. Louis, MO 3199 Riverport Tech Center Drive St. Louis, MO 63043

Date Received : January 15, 2004 Description : GW - Boeing

Sample ID

MW3W

Collected By : Jack E Friesner Collection Date : 01/14/04 16:30

Jack E Friesner

Site ID :

January 20, 2004

Project # : 3250035046

ESC Sample # : L141005-03

arameter	Result	Det. Limit	Units	Method	Date	Dil.
Methane	1.6	1.0	ppm	8015M	01/15/04	ı
Chloride	480	5.0	mq/l	9056	01/16/04	5
Nitrate	$\mathtt{BDL}$	0.10	mq/l	9056	01/16/04	1
Nitrite	BDL	0.10	mg/l	9056	01/16/04	1
Sulfate	41.	5.0	mg/l	9056	01/16/04	1
Free Carbon Dioxide	140	50.	mg/l	406B	01/15/04	5
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	2.0	1.0	mg/l	5310B	01/19/04	1
Sulfide	0.077	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	1.7	1.0	mg/l	9060	01/15/04	1
Iron	5.8	0.050	mq/l	6010B	01/16/04	1
Iron, Dissolved	0.70	0.050	mg/l	6010B	01/17/04	1
Manganese, Dissolved	2.1	0.010	mg/l	6010B	01/17/04	1
olatile Organics						
Acetone	$\mathtt{BDL}$	0.050	mg/l	8260B	01/15/04	1
Acrolein	$\mathtt{BDL}$	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	$\mathtt{BDL}$	0.050	mg/l	8260B	01/15/04	1
Benzene	BDL	0.0010	mg/1	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
Bromodichloromethane	$\mathtt{BDL}$	0.0010	mg/1	8260B	01/15/04	1
Bromoform	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	1
Bromomethane	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	1
n-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	ī
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	ī
Carbon tetrachloride	BDL	0.0010	mg/l	8260B	01/15/04	ī
Chlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	ī
Chlorodibromomethane	BDL	0.0010	mg/1	8260B	01/15/04	ī
Chloroethane	BDL	0.0010	mq/1	8260B	01/15/04	ī

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO

3199 Riverport Tech Center Drive St. Louis, MO 63043

January 20, 2004

Site ID :

Date Received : January 15, 2004

Description GW - Boeing

Sample ID MW3W

Collected By : Jack E Friesner Collection Date : 01/14/04 16:30

ESC Sample # : L141005-03

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
2-Chloroethyl vinyl ether	BDL	0.050	mg/l	8260B	01/15/04	1
Chloroform	BDL	0.0050	mg/l	8260B	01/15/04	1
Chloromethane	BDL	0.0010	mg/1	8260B	01/15/04	1
2-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
4-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,2-Dibromo-3-Chloropropane	BDL	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromoethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/1	8260B	01/15/04	1
1,2-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,4-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Dichlorodifluoromethane	BDL	0.0010	mq/1	8260B	01/15/04	ī
1,1-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,2-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethene	0.014	0.0010	mg/1	8260B	01/15/04	ī
cis-1,2-Dichloroethene	2.6	0.0010	mg/l	8260B	01/15/04	ī
trans-1,2-Dichloroethene	0.10	0.0010	mg/l	8260B	01/15/04	ī
1,2-Dichloropropane	BDL	0.0010	mg/1	8260B	01/15/04	1
1,1-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,3-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
cis-1,3-Dichloropropene	BDL	0.0010	mg/1	8260B	01/15/04	1
trans-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	ī
2,2-Dichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
Di-isopropyl ether	BDL	0.0010	mq/l	8260B	01/15/04	1
Ethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Hexachlorobutadiene	BDL	0.0010	mg/l	8260B	01/15/04	1
Isopropylbenzene	BDL	0.0010	mg/1	8260B	01/15/04	ī
p-Isopropyltoluene	BDL	0.0010	mg/l	8260B	01/15/04	ī
2-Butanone (MEK)	BDL	0.050	mg/l	8260B	01/15/04	ī
Methylene Chloride	BDL	0.0050	mg/l	8260B	01/15/04	1
4-Methyl-2-pentanone (MIBK)	BDL	0.050	mg/1	8260B	01/15/04	1
Methyl tert-butyl ether	BDL	0.0010	mg/l	8260B	01/15/04	ī
Naphthalene	BDL	0.0050	mg/l	8260B	01/15/04	ī
n-Propylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	ī
Styrene	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,1,1,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/l	8260B	01/15/04	ī
Tetrachloroethene	BDL	0.0010	mg/l	8260B	01/15/04	ī

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO

3199 Riverport Tech Center Drive St. Louis, MO 63043

ESC Sample # : L141005-03

January 20, 2004

Site ID :

Date Received :

January 15, 2004 :

Description

GW - Boeing

Sample ID

MW3W

Collected By Collection Date : Jack E Friesner 01/14/04 16:30

Project #: 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Toluene	BDL	0.0050	mg/l	8260B	01/15/04	1
1,2,3-Trichlorobenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
1,1,1-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	0.034	0.0010	mq/1	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,2,4-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,2,3-Trimethylbenzene	BDL	0.0010	mg/1	8260B	01/15/04	ī
1,3,5-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	ī
Vinyl chloride	1.0	0.0010	mq/l	8260B	01/15/04	ī
Xylenes, Total	BDL	0.0030	mg/1	8260B	01/15/04	ī
Surrogate Recovery			<b>3</b> , -		14, 40, 11	_
Toluene-d8	100		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	ī
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	ī

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233 Note:

The reported analytical results relate only to the sample submitted. This report shall not be reproduced, except in full, without the written approval from ESC.

Reported: 01/20/04 09:23 Printed: 01/20/04 15:02

ESC Representative

#### Attachment A List of Analytes with QC Qualifiers

Sample #	Analyte	Qualifier
L141005-01	DOC	
	Chloride	J4
	Acrolein	J4
	Bromodichloromethane	J3
	Bromomethane	<b>J</b> 3
	2-Chloroethyl vinyl ether	<b>J</b> 4J3
	Dibromomethane	J3
	cis-1,2-Dichloroethene	E
	1,2-Dichloropropane	<b>J</b> 3
	2-Butanone (MEK)	<b>J</b> 3
	4-Methyl-2-pentanone (MIBK)	Ј3
	Trichloroethene	E
	1,2,3-Trichloropropane	J3
L141005-02	DOC	W
	Chloride	J4
	Nitrite	L Q
	Acrolein	J <b>4</b> J5
	Acrylonitrile	J3
	2-Chloroethyl vinyl ether	J4
	2-Butanone (MEK)	<b>J</b> 3
	Methyl tert-butyl ether	J5
	1,1,2,2-Tetrachloroethane	J3
L141005-03	DOC	W
	Chloride	J4
	Acrolein	J4
	Bromodichloromethane	<u>J3</u>
	Bromomethane	J3
	2-Chloroethyl vinyl ether	J4J3
	Dibromomethane	<b>J</b> 3
	cis-1,2-Dichloroethene	E
	1,2-Dichloropropane	<u>J3</u>
	2-Butanone (MEK)	J3
	4-Methyl-2-pentanone (MIBK)	J3
	1,2,3-Trichloropropane	<u>J</u> 3
	Vinyl chloride	E

# Attachment B Explanation of QC Qualifier Codes

Qualifier	Meaning
E	GTL (EPA) - Greater than upper calibration limit: Actual value is known to be greater than the upper calibration range.
J3	The associated batch QC was outside the established quality control range for precision. $\  \  \  \  \  \  \  \  \  \  \  \  \ $
J4	The associated batch QC was outside the established quality control range for accuracy.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high
Q	(ESC) Sample held beyond the accepted holding time.
L	(ESC)Sample Pretreatment: The sample reaction impaired the ability to analyze the sample using normal analytical determination. Treatment outside of method protocol was required to determine the analytical result.
W	(ESC)-The laboratory analysis was from a sample collected in an improper container

#### Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods, it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable unless qualified as 'R' (Rejected).

#### Definitions

- Accuracy The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.
- Precision The agreement between a set of samples or between duplicate samples.

  Relates to how close together the results are and is represented by Relative Percent Difference.
- Surrogate Organic compounds that are similar in chemical composition, extraction, and chromotography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

  Control Limits

2-Fluorophenol 31-119 Nitrobenzene-d5 43-118 Dibromfluoromethane 79-126 83-119 Phenol-d5 12-134 2-Fluorobiphenyl 45-128 Toluene-d8 81-114 82-116 2,4,6-Tribromophenol 51-141 Terphenyl-d14 43-137 4-Bromofluorobenzene 65-129 72-126

TIC - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

# Summary of Remarks For Samples Printed 01/20/04 at 15:02:58

TSR Signing Reports: 206 R5 - Desired TAT

Needs EDD in PPB format.

Sample: L141005-01 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23 Needs EDD PPM FORMAT
Sample: L141005-02 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23 Needs EDD PPM FORMAT Sample: L141005-03 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23 Needs EDD PPM FORMAT



Tax I.D. 62-0814289

Est. 1970

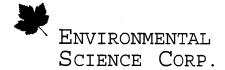
MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

St. Louis, MO 63043

Quality Assurance Report Level II

L141005

Nitrate	Analyte	Labor Result	atory Blank Units Date Analyzed	Batch		
Nitrite			•			
Tron		· ·				
Tron						
Tron	Sulfate	< 5	mg/l 01/15/04 18:08	WG140525		
Tree Carbon Dioxide	TOC (Total Organic Carbon)	< 1	mg/l 01/15/04 13:17	WG140588		
1.1.1,2-Tetrachloroethane	Iron	< .05	mg/l 01/16/04 02:18	WG140610		
1,1,1-Trichloroethane	Free Carbon Dioxide	< 10	mg/l 01/15/04 17:30	WG140619		
1,1,1-Trichloroethane	1.1.1.2-Tetrachloroethane	< .001	mg/l 01/15/04 14:36	WG140662		
1,1,2-Trichloro-1,2,2-trifluoroethane						
1,1,2-Trichloro-1,2,2-trifluoroethane						
1.1.2-Trichloroethane						
1,1-pichloroethane						
1.1-Dichloropetheme						
1.1-pichloropropene						
1,2,3-Trichloropenzene						
1, 2, 3-Trichloropropane						
1, 2, 3-Trimethylbenzene       < .001						
1, 2, 4-Trichlorobenzene       < .001						
1,2-1 trimethylbenzene						
2.2-Dibromo-3-Chloropropane						
1,2-Dibromoethane 1,2-Dichlorobenzene 1,2-Dichlorobenzene 2,001 mg/l 01/15/04 14:36 WG140662 1,2-Dichloropropame 3,001 mg/l 01/15/04 14:36 WG140662 1,2-Dichloropropame 4,001 mg/l 01/15/04 14:36 WG140662 1,3-Dichloropropame 5,001 mg/l 01/15/04 14:36 WG140662 1,3-Dichloropropame 6,001 mg/l 01/15/04 14:36 WG140662 1,3-Dichloropropame 7,001 mg/l 01/15/04 14:36 WG140662 1,3-Dichloropropame 8,001 mg/l 01/15/04 14:36 WG140662 1,4-Dichloropropame 9,001 mg/l 01/15/04 14:36 WG140662 2-Butanone (MEK) 9,05 mg/l 01/15/04 14:36 WG140662 2-Butanone (MEK) 9,05 mg/l 01/15/04 14:36 WG140662 2-Chlorocthyl vinyl ether 9,05 mg/l 01/15/04 14:36 WG140662 2-Chlorotoluene 9,001 mg/l 01/15/04 14:36 WG140662 2-Chlorotoluene 9,001 mg/l 01/15/04 14:36 WG140662 4-Chlorotoluene 9						
1,2-Dichlorobenzene						
1,2-Dichloroethane       < .001						
1,2-Dichloropropane       <.001						
1,3,5-Trimethylbenzene	1.2-Dichloropropage					
1,3-Dichlorobenzene						
1,3-Dichloropropane						
1,4-Dichloropenærene       < .001						
2,2-Dichloropropane       < .001						
2-Butanone (MEK)						
2-Chloroethyl vinyl ether						
2-Chlorotoluene						
4-Chlorotoluene       < .001						
4-Methyl-2-pentanone (MIBK)       < .05						
Acetone						
Acrolein						
Acrylonitrile						
Benzene         < .001         mg/l         01/15/04         14:36         WG140662           Bromobenzene         < .001						
Bromobenzene         < .001         mg/l         01/15/04         14:36         WG140662           Bromodichloromethane         < .001						
Bromodichloromethane         < .001         mg/l         01/15/04         14:36         WG140662           Bromoform         < .001			mg/1 01/15/04 14:36			
Bromoform         < .001         mg/l         01/15/04         14:36         WG140662           Bromomethane         < .001			mg/1 01/15/04 14:36			
Bromomethane       < .001						
Carbon tetrachloride       < .001						
Chlorobenzene       < .001						
Chlorodibromomethane       < .001						
Chloroethane       < .001       mg/l       01/15/04 14:36       WG140662         Chloroform       < .005						
Chloroform       < .005       mg/l       01/15/04 14:36       WG140662         Chloromethane       < .001						
Chloromethane     < .001			mg/1 01/15/04 14:36			
cis-1,2-Dichloroethene     < .001						
cis-1,3-Dichloropropene     < .001						
Di-isopropyl ether       < .001						
Dibromomethane       < .001       mg/l       01/15/04 14:36       WG140662         Dichlorodifluoromethane       < .001	Di-isonronyl ether					
Dichlorodifluoromethane < .001 mg/l 01/15/04 14:36 WG140662 Ethylbenzene < .001 mg/l 01/15/04 14:36 WG140662						
Ethylbenzene < .001 mg/1 01/15/04 14:36 WG140662						
	Hexachlorobutadiene					
Hexachlorobutadiene < .001 mg/l 01/15/04 14:36 WG140662 Isopropylbenzene < .001 mg/l 01/15/04 14:36 WG140662						



Tax I.D. 62-0814289

Est. 1970

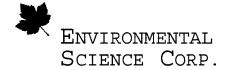
MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

Quality Assurance Report Level II

St. Louis, MO 63043

L141005

Methyl tert-butyl ether	< .001		mg/l	01/15/04 1	4:36	WG140662	<u> Barthagailte</u>
Analyte		Labora	tory Blan			_	
	Result		Units	Date Analy	zed	Batch	<del></del>
Methylene Chloride n-Butylbenzene	< .005 < .001		mg/l mg/l	01/15/04 1 01/15/04 1		WG140662 WG140662	
n-Propylbenzene	< .001		mg/l	01/15/04 1	4:36	WG140662	
Naphthalene p-Isopropyltoluene	< .005 < .001		mg/l mg/l	01/15/04 1 01/15/04 1		WG140662	n ing Propinsi in
sec-Butylbenzene	< .001		mg/l	01/15/04 1		WG140662 WG140662	
Styrene tert-Butylbenzene	< .001 < .001		mg/l mg/l	01/15/04 1 01/15/04 1		WG140662	
Tetrachloroethene	< .001		mg/l	01/15/04 1		WG140662 WG140662	
Toluene trans-1,2-Dichloroethene	< .005 < .001		mg/l mg/l	01/15/04 1 01/15/04 1		WG140662	주인 수가 수
trans-1,3-Dichloropropene	< .001		mg/l	01/15/04 1		WG140662 WG140662	
Trichloroethene Trichlorofluoromethane	< .001 < .001		mg/l mg/l	01/15/04 1 01/15/04 1		WG140662	
Vinyl chloride	< .001		mg/1	01/15/04 1		WG140662 WG140662	
Xylenes, Total	< .003		mg/l	01/15/04 1	4:36	WG140662	
Iron, Dissolved	< .05		mg/l	01/17/04 0	1:16	WG140681	
Manganese, Dissolved	< .01		mg/l	01/17/04 0	1:16	WG140681	
Chloride	< 1		mg/l	01/16/04 1	8:17	WG140706	
Nitrite	< .1		mg/l	01/16/04 1	8:17	WG140706	
Sulfide	< .05		mg/l	01/16/04 1	5:00	WG140829	extension and
DOC	< 1		mg/l	01/19/04 1	1:44	WG140996	
		Dun	licate				
Analyte	Units	Result	Duplica	te RPD	Limit	Ref Samp	Batch
Nitrate	mg/l	0.00	0.00	0.00	20	L141005-03	WG140525
Nitrite Sulfate		0.00	0.00	0.00	20	L141005-03	WG140525
	mg/l 4	0.8	41.0	0.585	20	L141005-03	WG140525
TOC (Total Organic Carbon)	mg/l	0.00	0.00	0.00	20	L140971-02	WG140588
Free Carbon Dioxide	mg/l 11	9.	120.	0.837	20	L141005-02	WG140619
Sulfide	mg/l	0.0848	0.077	0 9.64	20	L141005-03	WG140829
DOC	mg/l	1.23	1.40	13.0	20	L141005-02	WG140996
	Labor	atory (	Control S	ample			
Analyte	Units	Known		esult	% Rec	Limit B	atch
Nitrate	mg/l	4	3	.68	92.0	90-110 W	G140525
Nitrite Sulfate	mg/1	4 20		.55	88.8	85-115 W	G140525
	mg/l	20	1/	. 7	88.6	90-110 W	G140525
TOC (Total Organic Carbon)	mg/l	4	4	.40	110.	85-115 W	G140588
Iron	mg/l	1.13	1	.04	92.0	85-115 W	G140610
1,1,1,2-Tetrachloroethane	mg/l	.02		.0211	105.		G140662
1,1,1-Trichloroethane 1,1,2,2-Tetrachloroethane	mg/l mg/l	.02 .02		.0181 .0210	90.5 105.		G140662 G140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/1	.02	0	.0157	78.5		G140662 G140662
1,1,2-Trichloroethane 1,1-Dichloroethane	mg/l mg/l	.02		.0190 .0188	95.2 94.2	82-117 W	G140662
	5/ -		U	. 0100	24.4	59-135 W	G140662



Tax I.D. 62-0814289

Est. 1970

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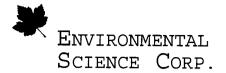
St. Louis, MO 63043

Quality Assurance Report

L141005

Level II

		2212000				
1,1-Dichloroethene	mg/l	.02	0.0182	90.8	60-166	WG140662
	Labo:	ratory Contro	l Sample			
Analyte	Units	Known Val	Result	% Rec	Limit	Batch
1,1-Dichloropropene	mg/l	.02	0.0172	85.8	67-132	WG140662
1,2,3-Trichlorobenzene	mg/l	.02	0.0210	105.	81-122	WG140662
1,2,3-Trichloropropane	mg/l	.02	0.0205	102.	78-122	WG140662
1,2,3-Trimethylbenzene	mg/1	.02	0.0169	84.3	64-100	WG140662
1,2,4-Trichlorobenzene 1,2,4-Trimethylbenzene	mg/l	.02 .02	0.0214 0.0204	107. 102.	78-132 82-117	WG140662 WG140662
1,2-Dibromo-3-Chloropropane	mg/l mg/l		0.0201	102.	58-140	WG140662
1,2-Dibromoethane	mg/1	.02	0.0201	101.	79-121	WG140662 WG140662
1,2-Dichlorobenzene	mg/1	.02	0.0203	97.3	83-113	WG140662
1,2-Dichloroethane	mg/l	.02		98.5	81-122	WG140662
1,2-Dichloropropane	mg/l	.02	0.0247	124.	74-125	WG140662
1,3,5-Trimethylbenzene	mg/l	.02	0.0197	98.4	80-118	WG140662
1,3-Dichlorobenzene	mg/1		0.0209	104.	80-124	WG140662
1,3-Dichloropropane	mg/l	.02	0.0202	101.	86-120	WG140662
1,4-Dichlorobenzene	mg/l	.02	0.0194	97.2	84-115	WG140662
2,2-Dichloropropane	mg/l	.02	0.0192	95.9	71-131	WG140662
2-Butanone (MEK)	mg/1	.1	0.106	106.	25-137	WG140662
2-Chloroethyl vinyl ether	mg/1	.1	0.00188	1.88	15-161	WG140662
2-Chlorotoluene	mg/l	.02	0.0192	96.1	79-112	WG140662
4-Chlorotoluene	mg/l	.02	0.0198	99.0	82-116	WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	. 1	0.108	108.	57-145	WG140662
Acetone	mg/l	.1	0.0916	91.6	14-115	WG140662
Acrolein	mg/l mg/l	.1 .1	0.201 0.0916	201. 91.6	16-83 32-142	WG140662
Acrylonitrile Benzene	mg/1	.02	0.0316	93.3	66-127	WG140662 WG140662
Bromobenzene	mg/1	.02	0.0207	104.	79-127	WG140662
Bromodichloromethane	mg/1	.02	0.0218	109.	76-117	WG140662
Bromoform	mg/l	.02	0.0220	110.	72-125	WG140662
Bromomethane	mg/l	.02	0.0102	51.1	25-170	WG140662
Carbon tetrachloride	mg/l	.02	0.0180	89.9	65-127	WG140662
Chlorobenzene	mg/l	.02	0.0195	97.6	79-117	
Chlorodibromomethane	mg/l	.02	0.0197	98.3	76-115	WG140662
Chloroethane	mg/l	.02	0.0133	66.7	37-130	WG140662
Chloroform	mg/l	.02	0.0191	95.6	70-119	WG140662
Chloromethane	mg/1	.02	0.0104	52.0	39-109	WG140662
cis-1,2-Dichloroethene	mg/1	.02	0.0185	92.5	72-128	WG140662
cis-1,3-Dichloropropene	mg/l	.02	0.0210	105.	86-137	WG140662
Di-isopropyl ether	mg/1	.02	0.0207	103.	54-147	WG140662
Dibromomethane	mg/l	.02	0.0217	109.	81-117	WG140662
Dichlorodifluoromethane Ethylbenzene	mg/l	.02 .02	0.00559 0.0187	28.0 93.6	14-133	WG140662
Hexachlorobutadiene	mg/l mg/l	.02	0.0187	87.8	75-117 68-122	WG140662 WG140662
Isopropylbenzene	mg/1	.02	0.0173	86.5	67-113	WG140662
Methyl tert-butyl ether	mg/1	.02	0.0218	109.	65-128	WG140662
Methylene Chloride	mg/l	.02	0.0191	95.4	60-127	WG140662
n-Butylbenzene	mg/l	.02	0.0188	94.1	74-125	WG140662
n-Propylbenzene	mg/l	.02	0.0191	95.5	74-120	WG140662
Naphthalene	mg/l	.02	0.0183	91.6	51-127	WG140662
p-Īsopropyltoluene	mg/l	.02	0.0196	97.9	74-122	WG140662
sec-Butylbenzene	mg/l	.02	0.0182	90.9	66-118	WG140662
Styrene	mg/l	.02	0.0198	99.2	78-114	WG140662
tert-Butylbenzene	mg/l	.02	0.0201	101.	69-121	WG140662
Tetrachloroethene	mg/l	.02	0.0187	93.3	71-132	WG140662
Toluene	mg/l	.02	0.0194	97.1	68-122	WG140662
trans-1,2-Dichloroethene	mg/l	.02	0.0176	88.0	65-141	WG140662
trans-1,3-Dichloropropene Trichloroethene	mg/l	.02	0.0198	98.8	82-132	WG140662
Trichlorofluoromethane	mg/l mg/l	.02 .02	0.0181 0.0125	90.7 62.7	81-129 46-94	WG140662
Vinyl chloride	mg/1	.02	0.0125	57.6	40-95	WG140662 WG140662
· · · · · · · · · · · · · · · · · · ·	9/ -	. 52	0.0113	37.0	40-22	#G14000Z



Tax I.D. 62-0814289

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99 Riverport Tech Center Drive Quality Assurance Report Level II

St. Louis, MO 63043

L141005

Xylenes, Total	mg/l	.06	0.0574	95.7	78-114	WG140662
Analyte	Lak Units	oratory Co Known V	ontrol Sample Val Result	% Rec	Limit	Batch
Iron, Dissolved Manganese, Dissolved	mg/l mg/l	1.13 1.13	1.19	105. 106.	85-115 85-115	WG140681 WG140681
Chloride Nitrite	mg/l mg/l	20 4	17.0 3.56	85.1 89.1	90-110 85-115	WG140706 WG140706
Sulfide	mg/l	.5	0.530	106.	85-115	WG140829
DOC	mg/l	4	4.60	115.	85-115	WG140996
Analyte	Laborato Units	ry Control LCSD Res	Sample Duplicate	Limit	Ref Samp	Batch
Nitrate Nitrite Sulfate	mg/l mg/l mg/l	3.62 3.54 17.6	3.68 1.59 3.55 0.421 17.7 0.872	20 20 20	R184382-5 R184382-5 R184382-5	
TOC (Total Organic Carbon)	mg/l	4.30	4.40 2.30	20	WG140588-	2 WG140588
Iron	mg/l	1.06	1.04	20	R184336-3	WG140610
1,1,1,2-Tetrachloroethane 1,1,1-Trichloroethane 1,1,2-Trichloroethane 1,1,2-Trichloroethane 1,1,2-Trichloroethane 1,1-Dichloroethane 1,1-Dichloroethane 1,1-Dichloroethane 1,1-Dichloropropene 1,2,3-Trichlorobenzene 1,2,3-Trichlorobenzene 1,2,4-Trichlorobenzene 1,2,4-Trimethylbenzene 1,2,4-Trimethylbenzene 1,2-Dibromo-3-Chloropropane 1,2-Dibromoethane 1,2-Dichlorobenzene 1,2-Dichlorobenzene 1,3-Dichloropropane 1,3-Dichloropropane 1,3-Dichloropropane 1,3-Dichlorobenzene 1,3-Dichlorobenzene 1,3-Dichloropropane 1,4-Dichlorobenzene 2,2-Dichloropropane 2,2-Dichlorotoluene 4-Chlorotoluene 4-Methyl-2-pentanone (MIBK) Acetone Acrolein Acrylonitrile Benzene Bromobenzene Bromodichloromethane	mg/1 mg/1 mg/1 mg/1 mg/1 mg/1 mg/1 mg/1	0.0208 0.0177 0.0198 0.0151 0.0184 0.0189 0.0175 0.0168 0.0210 0.0204 0.0172 0.0198 0.0185 0.0198 0.0193 0.0193 0.0194 0.0194 0.0192 0.0194 0.0195 0.	0.0211 1.24 0.0181 2.52 0.0210 5.83 0.0157 3.70 0.0190 3.31 0.0188 0.424 0.0182 3.64 0.0172 1.88 0.0210 5.39 0.0205 13.5 0.0169 0.535 0.0214 1.65 0.0204 0.245 0.0201 15.8 0.0203 6.31 0.0195 3.29 0.0197 6.45 0.0204 0.245 0.0201 0.608 0.0202 4.46 0.0194 0.930 0.0197 0.608 0.0202 4.46 0.0194 0.930 0.0192 3.93 0.106 11.1 0.0018 27.9 0.0192 0.156 0.0198 2.09 0.108 12.5 0.0916 7.20 0.0187 0.699 0.0207 1.65	16 28 10 40 16 17 36 31 13 20 25 29 16 13 14 22 15 18 21 22 24 22 22 21 22 23 24 22 22 22 23 24 25 26 27 27 28 28 28 28 28 28 28 28 28 28 28 28 28	R184421-5 R184421-5	WG140662 WG140662
Bromoform Bromomethane Carbon tetrachloride Chlorobenzene	mg/l mg/l mg/l mg/l	0.0189 0.0205 0.0082 0.0175 0.0193	0.0218 14.3 0.0220 6.97 0.0102 21.5 0.0180 2.53 0.0195 1.39	13 18 20 36 21	R184421-5 R184421-5 R184421-5 R184421-5 R184421-5	WG140662 WG140662 WG140662 WG140662 WG140662



Tax I.D. 62-0814289

Est. 1970

MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

Quality Assurance Report Level II

Ot Towin MO COOKS		2000	January 20, 2004				
St. Louis, MO 63043		L141005			Dandary 20, 2004		
Chlorodibromomethane	mg/l	0.0186	0.0197	5.54	17	R184421-5 WG140662	

	Laborato Units	ry Control LCSD Res		Ouplicate RPD	e. Lim:	<b>:</b> +-	Ref Samp	Batch
Analyte	UIIILS	LCSD Res	KET KES	KFD	<u> </u>	<u> </u>	Ker Samp	Baccii
Chloroethane	mg/l	0.0126	0.0133	6.10	25		R184421-5	WG140662
Chloroform	mg/l	0.0194	0.0191 0.0104	1.35 6.97	26 31		R184421-5 R184421-5	WG140662 WG140662
Chloromethane cis-1,2-Dichloroethene	mg/l mg/l	0.0097 0.0181	0.0104	2.24	18		R184421-5	WG140662
cis-1,3-Dichloropropene	mg/1	0.0203	0.0210	3.53	17		R184421-5	WG140662
Di-isopropyl ether	mg/l	0.0207	0.0207	0.386	13		R184421-5	WG140662
Dibromomethane	mg/l	0.0182	0.0217	17.5	12		R184421-5	WG140662
Dichlorodifluoromethane	mg/1	0.0053	0.0055	3.83	28		R184421-5	WG140662
Ethylbenzene	mg/l	0.0188	0.0187	0.160	25		R184421-5	WG140662
Hexachlorobutadiene	mg/l	0.0165	0.0176	5.99	36		R184421-5	WG140662
Isopropylbenzene	mg/l	0.0169	0.0173	2.04	29		R184421-5	WG140662
Methyl tert-butyl ether	mg/l	0.0208	0.0218	4.84	16		R184421-5	WG140662 J
Methylene Chloride	mg/l	0.0187 0.0187	0.0191	2.07 0.587	16 30		R184421-5 R184421-5	WG140662 WG140662
n-Butylbenzene n-Propylbenzene	mg/l mg/l	0.0190	0.0191	0.367	30		R184421-5	WG140662 #
Naphthalene	mq/1	0.0166	0.0183	9.67	39		R184421-5	WG140662
p-Isopropyltoluene	mg/1	0.0198	0.0196	0.916	36		R184421-5	WG140662
sec-Butylbenzene	mg/l	0.0184	0.0182	1.09	32		R184421-5	WG140662
Styrene	mg/l	0.0199	0.0198	0.151	21		R184421-5	WG140662
tert-Butylbenzene	mg/1	0.0200	0.0201	0.398	30		R184421-5	WG140662
Tetrachloroethene	mg/l	0.0188	0.0187	0.854	32		R184421-5	WG140662
Toluene	mg/l	0.0191	0.0194	1.87	17		R184421-5	
trans-1,2-Dichloroethene	mg/l	0.0176	0.0176	0.00	27		R184421-5	WG140662 WG140662
trans-1,3-Dichloropropene Trichloroethene	mg/l mg/l	0.0187 0.0178	0.0198	5.62 1.72	16 25		R184421-5 R184421-5	
Trichlorofluoromethane	mq/1	0.0178	0.0125	4.65	41		R184421-5	WG140662
Vinyl chloride	mg/1	0.0109	0.0115	5.81	36		R184421-5	WG140662
Xylenes, Total	mg/1	0.0586	0.0574	2.05	21		R184421-5	WG140662
Iron, Dissolved	ma / 1	1.21	1.19	1.67	20		R184440-3	WG140681
Manganese, Dissolved	mg/l mg/l	1.21	1.20	0.00	20		R184440-3	WG140681
nanganese, sibsoived	9/ =	1.20	1.20	, 0.00	2.0		11101110 5	
Chloride	mg/l	16.7	17.0	1.66	20		R184491-2	WG140706
Nitrite	mg/1	3.51	3.56	1.51	20		R184491-2	WG140706
Sulfide	mg/l	0.500	0.530	5.83	20		WG140829-2	WG140829
Builine	g/ 1	0.300	0.550		20		NG140025 2	
DOC	mg/l	3.90	4.60	16.5	20		WG140996-2	WG140996
		Matriz	c Spike					4
Analyte	Units	MS Res	Ref Res	TV %	Rec	Limit	Ref Samp	Batch_
Ni baaba	/ l	4 : 77.4	0.0000	_	04.4	00 10	0 1140643	21 MC140525
Nitrate Nitrite	mg/l mg/l	$4.74 \\ 4.72$	0.0228			80-12 80-12		-21 WG140525 -21 WG140525
Sulfate	mg/1	48.2	0.00			80-12		-21 WG140525
barrace	9/ ±	10.2	0.00		30.1	00 12	0 1110013	21 "0110323
TOC (Total Organic Carbon)	mg/1	20.0	0.00	20 1	00.	80-12	0 L140971	-01 WG140588
Iron	mg/l	1.05	0.00	1.13	93 N	75-12	5 T.141005.	-01 WG140610
	9/ 1	1.05	0.00	1.13	23.0	,5 12	S. HITTOUS	01 110110
1,1,1,2-Tetrachloroethane	mg/1	0.0210	0.00			67-13		-02 WG140662
1,1,1-Trichloroethane	mg/1	0.0183	0.00			46-14		-02 WG140662
1,1,2,2-Tetrachloroethane	mg/l	0.0211	0.00			70-11		-02 WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/l	0.0190	0.00			30-13		-02 WG140662
1,1,2-Trichloroethane 1,1-Dichloroethane	mg/1 mg/1	0.0174	0.00			70-12 47-13		-02 WG140662 -02 WG140662
1,1-Dichloroethene	mg/1	0.0203	0.00			56-16		-02 WG140662
1,1-Dichloropropene	mg/1	0.0187	0.00			49-14		-02 WG140662
1,2,3-Trichlorobenzene	mg/l	0.0155	0.00			63-12		-02 WG140662
	٠.							



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MACTEC - St. Louis, MO
Mr. Dennis Brinkley
3199 Riverport Tech Center Drive Quality Assurance Report
Level II

January 20, 2004

St. Louis, MO 63043

L141005

1,2,3-Trichloropropane	mg/l	0.0192	0.00	0.02	95.9 66-124	L141005-02	WG140662	
Matrix Spike								
Analyte	Units	MS Res	Ref Res	TV	% Rec Limit	Ref Samp	Batch	
1,2,3-Trimethylbenzene	mg/l	0.0163	0.00	0.02	81.7 51-109	L141005-02	WG140662	
1,2,4-Trichlorobenzene	mg/1	0.0151	0.00	0.02	75.6 52-130	L141005-02	WG140662	
1,2,4-Trimethylbenzene	mg/1	0.0220	0.00	0.02	110. 62-126	L141005-02	WG140662	
1,2-Dibromo-3-Chloropropane	mg/1	0.0199	0.00	0.02	99.5 48-122			
1,2-Dibromoethane	mg/1	0.0206	0.00	0.02	103. 74-121	L141005-02		
1,2-Dichlorobenzene	mg/l	0.0164	0.00	0.02	82.0 65-119	L141005-02 L141005-02		
1,2-Dichloroethane 1,2-Dichloropropane	mg/l mg/l	0.0188 0.0193	0.00	0.02	93.8 48-148 96.7 66-122	L141005-02		
1,3,5-Trimethylbenzene	mq/1	0.0194	0.00	0.02	96.8 60-127	L141005-02		
1,3-Dichlorobenzene	mg/1	0.0186	0.00	0.02	92.8 62-122			
1,3-Dichloropropane	mg/1	0.0206	0.00	0.02	103. 77-121	L141005-02		
1,4-Dichlorobenzene	mg/l	0.0160	0.00	0.02	79.8 60-123	L141005-02	WG140662	
2,2-Dichloropropane	mg/l	0.0193	0.00	0.02	96.4 40-148	L141005-02	WG140662	
2-Butanone (MEK)	mg/l	0.107	0.00	0.1	107. 26-114	L141005-02		
2-Chloroethyl vinyl ether	mg/l	0.00	0.00	0.1	0.0 0-100	L141005-02		
2-Chlorotoluene 4-Chlorotoluene	mg/l	0.0187	0.00	0.02	93.5 62-120	L141005-02		
4-Methyl-2-pentanone (MIBK)	mg/l mg/l	0.0185 0.0871	0.00 0.00	0.02	92.3 63-123 87.1 56-133	L141005-02 L141005-02		
Acetone (MIBR)	mg/1	0.0960	0.00	0.1	96.0 13-145			
Acrolein	mg/1	0.221	0.00	0.1	221. 14-90	L141005-02		
Acrylonitrile	mg/1	0.107	0.00	0.1	107. 33-128	L141005-02		
Benzene	mg/l	0.0215	0.00	0.02	107. 55-130			
Bromobenzene	mg/1	0.0197	0.00	0.02	98.4 67-134	L141005-02	WG140662	
Bromodichloromethane	mg/1	0.0183	0.00	0.02	91.5 57-126	L141005-02		
Bromoform	mg/1	0.0214	0.00	0.02	107. 52-130			
Bromomethane	mg/1	0.0119	0.00	0.02	59.5 17-150	L141005-02		
Carbon tetrachloride Chlorobenzene	mg/l mg/l	0.0187 0.0195	0.00	0.02	93.7 42-141	L141005-02 L141005-02		
Chlorodibromomethane	mg/l	0.0193	0.00	0.02	97.7 66-125 96.4 58-123	L141005-02		
Chloroethane	mg/1	0.0170	0.00	0.02	85.0 29-131	L141005-02		
Chloroform	mg/1	0.0191	0.00	0.02	95.5 46-136			
Chloromethane	mg/l	0.0173	0.00	0.02	86.4 26-120	L141005-02		
cis-1,2-Dichloroethene	mg/l	0.0230	0.0062	0.02	83.9 59-133	L141005-02	WG140662	
cis-1,3-Dichloropropene	mg/1	0.0171	0.00	0.02	85.3 77-132	L141005-02	WG140662	
Di-isopropyl ether	mg/l	0.0233	0.00	0.02	117. 47-141	L141005-02		
Dibromomethane	mg/l	0.0176	0.00	0.02	87.9 64-119	L141005-02		
Dichlorodifluoromethane Ethylbenzene	mg/l mg/l	0.0133	0.00	0.02	66.4 13-113			
Hexachlorobutadiene	mg/1	0.0198 0.0130	0.00	0.02	98.9 61-123 65.1 39-138	L141005-02 L141005-02		
Isopropylbenzene	mg/l	0.0172	0.00	0.02	85.8 56-120			
Methyl tert-butyl ether	mg/l	0.114	0.00	0.02	571. 43-140	L141005-02		
Methylene Chloride	mg/l	0.0205	0.00	0.02	103. 55-123	L141005-02		
n-Butylbenzene	mg/l	0.0153	0.00	0.02	76.4 43-139	L141005-02	WG140662	
n-Propylbenzene	mg/l	0.0187	0.00	0.02	93.7 57-127	L141005-02		
Naphthalene	mg/l	0.0205	0.00	0.02	102. 39-122	L141005-02		
p-Isopropyltoluene	mg/l	0.0181	0.00	0.02	90.6 58-127			
sec-Butylbenzene Styrene	mg/l mg/l	0.0180	0.00	0.02	89.8 55-124 98.6 61-119	L141005-02		
tert-Butylbenzene	mg/1	0.0197	0.00 0.00	0.02	96.5 58-129	L141005-02 L141005-02		
Tetrachloroethene	mg/l	0.0194	0.00	0.02	96.9 49-144	L141005-02		
Toluene	mq/1	0.0166	0.00	0.02	83.1 59-123	L141005-02		
trans-1,2-Dichloroethene	mg/1	0.0198	0.00	0.02	99.1 53-145			
trans-1,3-Dichloropropene	mg/1	0.0159	0.00	0.02	79.4 69-125	L141005-02	WG140662	
Trichloroethene	mg/1	0.0184	0.00	0.02	91.8 61-141			
Trichlorofluoromethane	mg/l	0.0144	0.00	0.02	72.2 24-113			
Vinyl chloride Xylenes, Total	mg/l	0.0175	0.0018		78.4 26-110			
Ayrenes, Total	mg/1	0.0650	0.00	0.06	108. 64-119	L141005-02	. MGT40007	
Iron, Dissolved	mg/l	11.9	11.0	1.13	82.3 75-125	L141005-02	WG140681	
, + +					J2.J /J 12J	005		



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MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

St. Louis, MO 63043

Quality Assurance Report Level II

L141005

		L14100	15					
Manganese,Dissolved	mg/l	7.70	6.70	1.13	88.6	75-125	L141005-02	WG140681
Matrix Spike								•
Analyte	Units	MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
Sulfide	mg/l	0.960	0.00	1.	96.0	80-120	L141005-01	WG140829
DOC	mg/l	20.0	2.60	20	87.0	80-120	L141005-01	WG140996
	N.	latriz Cni	ke Duplic	nto.				_
Analyte		MSD Res		RPD	Lim	it %Rec	Ref Samp	Batch
Nitrate	mg/1	4.76	4.74	0.271	20	94.7	L140643-2	1 WG140525
Nitrite	mg/l	4.75	4.72	0.544		95.0		1 WG140525
Sulfate	mg/l	48.3	48.2	0.151	20	96.6	L140643-2	1 WG140525
TOC (Total Organic Carbon)	mg/l	20.0	20.0	0.00	20	100.	L140971-0	1 WG140588
Iron	mg/l	1.09	1.05	3.37	20	96.2	L141005-0	1 WG140610
1,1,1,2-Tetrachloroethane	mg/l	0.0189	0.0210	10.3	16	94.5	T.141005~0	2 WG140662
1,1,1-Trichloroethane	mg/l	0.0189	0.0210	0.546		94.5		2 WG140662 2 WG140662
1,1,2,2-Tetrachloroethane	mg/1	0.0180	0.0211	15.7	10	90.1		2 WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/1	0.0180	0.0190	5.19	40	90.0		2 WG140662
1,1,2-Trichloroethane	mg/l	0.0170	0.0174	2.21	16	85.1		2 WG140662
1,1-Dichloroethane	mg/1	0.0193	0.0203	5.30	17	96.4	L141005-0	2 WG140662
1,1-Dichloroethene	mg/l	0.0202	0.0218	7.52	36	101.	L141005-0	2 WG140662
1,1-Dichloropropene	mg/1	0.0178	0.0187	4.87	33	89.2		2 WG140662
1,2,3-Trichlorobenzene	mg/1	0.0168	0.0155	8.00	17	83.8		2 WG140662
1,2,3-Trichloropropane	mg/l	0.0170	0.0192	12.0	13	85.1		2 WG140662
1,2,3-Trimethylbenzene	mg/l	0.0163	0.0163	0.245		81.5		2 WG140662
1,2,4-Trichlorobenzene	mg/l	0.0158	0.0151	4.15 9.58	25	78.8		2 WG140662
1,2,4-Trimethylbenzene 1,2-Dibromo-3-Chloropropane	mg/l	0.0200 0.0171	0.0220	14.9	29 21	99.9 85.7		2 WG140662 2 WG140662
1,2-Dibromoethane	mg/l mg/l	0.0171	0.0199 0.0206	14.3	19	89.3	1.141005-0	2 WG140662 2 WG140662
1,2-Dichlorobenzene	mg/1	0.0164	0.0164	0.122		82.1		2 WG140662
1,2-Dichloroethane	mg/1	0.0183	0.0188	2.70	13	91.3		2 WG140662
1,2-Dichloropropane	mg/1	0.0191	0.0193	1.25	14	95.5		2 WG140662
1,3,5-Trimethylbenzene	mg/1	0.0180	0.0194	7.23	28	90.1		2 WG140662
1,3-Dichlorobenzene	mg/l	0.0173	0.0186	7.20	25	86.3		2 WG140662
1,3-Dichloropropane	mg/l	0.0179	0.0206	14.4	15	89.3		2 WG140662
1,4-Dichlorobenzene	mg/l	0.0164	0.0160	2.41	18	81.8	L141005-0	2 WG140662
2,2-Dichloropropane	mg/l	0.0188	0.0193	2.31	31	94.2	L141005-0	2 WG140662
2-Butanone (MEK)	mg/1	0.0934	0.107	13.2	10	93.4	L141005-0	2 WG140662
2-Chloroethyl vinyl ether	mg/l	0.00	0.00	0.00	25	0.00		2 WG140662
2-Chlorotoluene	mg/l	0.0170	0.0187	9.41	24	85.1		2 WG140662
4-Chlorotoluene	mg/1	0.0167	0.0185	9.83	22	83.7		2 WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	0.0942	0.0871	7.79	12	94.2		2 WG140662
Acetone Acrolein	mg/l	0.0826 0.175	0.0960 0.221	15.0 23.6	23 34	82.6 175.		2 WG140662 2 WG140662
Acrylonitrile	mg/l mg/l	0.0930	0.107	13.8	13	93.0		2 WG140662 2 WG140662
Benzene	mg/1	0.0203	0.0215	5.41	20	102.		2 WG140662
Bromobenzene	mg/1	0.0183	0.0197	7.05	22	91.7		2 WG140662
Bromodichloromethane	mg/1	0.0181	0.0183	1.04	13	90.6		2 WG140662
Bromoform	mg/1	0.0191	0.0214	11.6	18	95.5		2 WG140662
Bromomethane	mg/1	0.0101	0.0119	15.9	20	50.7	L141005-0	2 WG140662
Carbon tetrachloride	mg/l	0.0185	0.0187	1.40	36	92.4		2 WG140662
Chlorobenzene	mg/l	0.0176	0.0195	10.5	21	88.0	L141005-0	2 WG140662
Chlorodibromomethane	mg/1	0.0169	0.0193	13.0	17	84.6		2 WG140662
Chloroethane	mg/l	0.0152	0.0170	10.9	25	76.2	L141005-0	2 WG140667
Chloroform	mg/1	0.0185	0.0191	3.36	26	92.3	L141005-0	2 WG140662
Chloromethane	mg/l	0.0153	0.0173	12.4	31	76.3		2 WG140662
cis-1,2-Dichloroethene cis-1,3-Dichloropropene	mg/l	0.0205	0.0230 0.0171	11.6	18	71.3		2 WG140662
cre-r'2-proutofrobene	mg/1	0.0194	0.01/1	12.8	17	97.0	TT#1000-0	2 WG140662



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Di-isopropyl ether	mg/l	0.0216	0.0233	7.65	13	108.	L141005-02	WG140662	
Matrix Spike Duplicate									
Analyte		MSD Res		RPD	Limit	%Rec	Ref Samp	Batch	
Dibromomethane	mg/l	0.0186	0.0176	5.85	12	93.2	L141005-02	WG140662	
Dichlorodifluoromethane	mg/l	0.0129	0.0133	3.29	28	64.3	L141005-02	WG140662	
Ethylbenzene	mg/l	0.0175	0.0198	12.2	25	87.5	L141005-02	WG140662	
Hexachlorobutadiene	mg/l	0.0141	0.0130	7.90	36	70.4	L141005-02	WG140662	
Isopropylbenzene	mg/1	0.0158	0.0172	8.51	29	78.8	L141005-02	WG140662	
Methyl tert-butyl ether	mg/l	0.102	0.114	11.5	16	509.	L141005-02	WG140662	
Methylene Chloride	mg/l	0.0194	0.0205	5.55	16	97.2	L141005-02	WG140662	
n-Butylbenzene	mg/l	0.0155	0.0153	1.24	30	77.4	L141005-02	WG140662	
n-Propylbenzene	mg/l	0.0169	0.0187	10.3	30	84.5	L141005-02	WG140662	
Naphthalene	mg/1	0.0211	0.0205	3.17	39	106.	L141005-02	WG140662	
p-Isopropyltoluene	mg/l	0.0171	0.0181	6.08	36	85.3	L141005-02	WG140662	
sec-Butylbenzene	mg/l	0.0165	0.0180	8.29	32	82.7	L141005-02	WG140662	
Styrene	mg/l	0.0175	0.0197	12.0	21	87.4	L141005-02	WG140662	
tert-Butylbenzene	mg/l	0.0181	0.0193	6.37	30	90.5	L141005-02	WG140662	
Tetrachloroethene	mg/l	0.0177	0.0194	9.01	32	88.6	L141005-02	WG140662	
Toluene	mg/1	0.0190	0.0166	13.4	17	95.0	L141005-02		
trans-1,2-Dichloroethene	mg/l	0.0187	0.0198	5.98	27	93.3	L141005-02	WG140662	
trans-1,3-Dichloropropene	mg/l	0.0180	0.0159	12.8	16	90.2	L141005-02		
Trichloroethene	mg/l	0.0181	0.0184	1.43	25	90.5	L141005-02	WG140662	
Trichlorofluoromethane	mg/1	0.0140	0.0144	3.02	41	70.1	L141005~02	WG140662	
Vinyl chloride	mg/l	0.0160	0.0175	8.90	36	71.0	L141005-02	WG140662	
Xylenes, Total	mg/l	0.0582	0.0650	11.1	21	96.9	L141005-02	WG140662	
Iron, Dissolved	mg/l	11.9	11.9	0.513	20	76.9	L141005-02	WG140681	
Manganese, Dissolved	mg/l	7.69	7.70	0.143	20	87.6	L141005-02	WG140681	
Sulfide	mg/l	0.990	0.960	3.08	20	99.0	L141005-01	WG140829	
DOC	mg/l	20.0	20.0	0.00	20	87.0	L141005-01	WG140996	

Batch number /Run number / Sample number cross reference

WG140657: R184316: L141005-01 02 03 WG140619: R184323: L141005-01 02 03 WG140610: R184336: L141005-01 02 03 WG140610: R184336: L141005-01 02 03 WG140588: R184349: L141005-01 02 03 WG140525: R184382: L141005-01 02 03 WG140662: R184421: L141005-01 02 03 WG140681: R184440: L141005-01 02 03 WG140829: R184444: L141005-01 02 03 WG140706: R184491: L141005-01 02 03 WG140996: R184578: L141005-01 02 03

<sup>\*</sup> See Attachment B of standard report for list of qualifiers.
\* Calculations are performed prior to rounding of reported values .



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MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

3199 Riverport Tech Center Driv St. Louis, MO 63043 Quality Assurance Report Level II

L141005

January 20, 2004

ESC Level 2 Data Package

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of regent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.

# Enhanced Bioremediation Pilot Test Report for McDonnell Douglass, Hazelwood, Missouri

Prepared for: The Boeing Company St. Louis, Missouri



Prepared by:
MACTEC Engineering and Consulting, Inc.
3199 Riverport Tech Center Drive
St. Louis, Missouri 63043

MACTEC Project Number 32350035046

April 2, 2004



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#### List of Abbreviations and Acronyms

below ground surface bgs **Boeing Company** Boeing °C degrees Celsius ٥F degrees Fahrenheit dichloroethane DCA **DCE** dichloroethene DO dissolved oxygen DOC dissolved organic carbon Boeing Tract 1 facility Facility

HRC Hydrogen Release Compound

MACTEC Engineering and Consulting, Inc.

 $\begin{array}{ll} \mu g/L & \text{micrograms per liter} \\ mg/L & \text{milligrams per liter} \end{array}$ 

mV millivolt ORP redox potential

PCE perchloroethylene, tetrachloroethene

PVC polyvinyl chloride Redox oxidation-reduction

RCRA Resource Conservation and Recovery Act

RFI RCRA Facility Investigation

TCE trichloroethane
TOC total organic carbon

TPH total petroleum hydrocarbon

USEPA U.S. Environmental Protection Agency

VC vinyl chloride

VOC volatile organic compounds

# 1.0 Introduction

This report presents the results of an enhanced bioremediation pilot study conducted by MACTEC Engineering and Consulting, Inc. (MACTEC) on behalf of McDonnell Douglass, a wholly owned subsidiary of The Boeing Company (Boeing). The objective of the pilot study was to measure the ability of a Hydrogen Release Compound® (HRC) to enhance biological activity of reductive dehalogenating microbes to dechlorinate trichloroethene (TCE) and other chlorinated aliphatic hydrocarbons under anaerobic conditions in shallow groundwater at the Boeing Tract 1 Facility (Facility) located in Hazelwood, Missouri (Figure 1-1). The conclusions and results of the pilot study will assist in the development of a Corrective Measure Study for the Boeing Tract 1 Facility.

# 2.0 Facility Description

The pilot study was conducted at the former Boeing Fabrication Operations Facility (consisting of Buildings 27, 29 and 29A), which is now operated by GKN Aerospace Services. Aircraft components are manufactured at the Fabrications Operations Facility, which has been in operation at the site since 1941. The Fabrication Operations Facility is located on Boeing Tract 1 North, which is bounded on the west by Lindbergh Boulevard, on the south by Banshee Road, and on the east by Coldwater Creek. McDonnell Boulevard bounds the northern portion of the Facility (Figure 2-1).

The Facility is located on generally flat topography in an area known as the Florissant Basin. The Florissant Basin consists of a broad valley cut by the ancestral Coldwater Creek and tributaries. This basin was subsequently in-filled by unconsolidated clay and organic silt deposits approximately 80 feet thick at the Facility. The bedrock unit underlying the unconsolidated deposits consists of Mississippian Age Ste. Genevieve limestone.

At the pilot test area, the surficial material consisted of silty clay. Plasticity in the soil increased with depth from moderate to high between the surface and 20 feet below ground surface (bgs). The upper 15 feet of soil had abundant iron oxidation staining and contained vertical root traces/worm burrows up to 1/8<sup>th</sup> inch diameter that were infilled with iron oxidation. Below 20 feet bgs the surficial material consisted of increasingly plastic clay.

Shallow groundwater at the pilot test area was encountered between 2 and 6 feet bgs. The shallow groundwater gradient is to the east. The average facility-wide hydraulic gradient was calculated at 0.0107 feet per foot and the average facility-wide linear groundwater velocity was calculated at 7.6 feet per year. Additional site characterization data regarding the Boeing Tract 1 Facility is presented in the Draft Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report (MACTEC, 2003).

# 3.0 Technology Description

The most important process for the natural degradation of chlorinated compounds is that of reductive dechlorination. Chlorinated ethenes [tetrachloroethene (PCE), TCE, dichloroethene (DCE), vinyl chloride (VC)] are transformed by sequential dechlorination from PCE to TCE to DCE to VC to ethene (U.S. Environmental Protection Agency (USEPA), 1998). The chlorinated compound is utilized as an electron acceptor, with a chlorine atom removed and replaced with a hydrogen atom. Complete reductive dechlorination produces ethane or methane and carbon dioxide (Figure 3-1).

## 3.1 Environmental Conditions that Support Reductive Dechlorination

Reductive dechlorination occurs under strongly reducing (anaerobic) conditions and requires carbon as a food source for microbes. Environmental conditions that support reductive dechlorination include:

- > Microorganisms capable of degrading the contaminants;
- > Oxidation-reduction (redox) potential of the groundwater;
- > Sufficient electron donors (e.g. a carbon source);
- > Limited competing electron acceptors.

#### 3.1.1 Microorganisms

Reductive dechlorination of chlorinated compounds relies on microorganisms that produce enzymes that degrade the contaminants. Generally, if products of complete dechlorination are evident at a site, microorganisms necessary for dechlorination can be assumed to be present (Wisconsin Department of Natural Resources, 2003). At the Facility, degradation products DCE and VC are present in the shallow groundwater in conjunction with PCE and TCE, indicating that dehalogenating microorganisms are present.

#### 3.1.2 Oxidation-Reduction Potential (ORP)

ORP (redox) of groundwater is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. In general, a groundwater ORP of less than negative 100 millivolts (mV) indicates that a reductive pathway is likely (USEPA, 1998). However, while ORP can indicate the likelihood of reductive dechlorination occurring, the aquifer redox condition cannot predict the extent to which reductive dechlorination will occur (Loffler et al., 1999). At the Facility, ORP in groundwater was measured to be lower than negative 100 mV in several areas where chlorinated compounds were detected.

#### 3.1.3 Carbon Source

Because chlorinated compounds are utilized as electron acceptors during reductive dechlorination, an appropriate carbon source is required for microbial growth (and resulting production of hydrogen) to occur. Potential carbon sources include low molecular weight organic compounds (lactate, acetate, methanol, glucose, etc.), fuel hydrocarbons, or naturally occurring organic matter. At the Facility the geology of the shallow surficial soil consists of silts and clays of lacustrine (lake) origin with a high organic content. Additionally, anthropogenic carbon sources (fuel hydrocarbons such as fuel oil, jet fuel, and cutting oil) are present at the Facility in several areas where chlorinated compounds were detected.

#### 3.1.4 Competing Electron Acceptors

Dissolved oxygen (DO) is the most favored electron acceptor used by microbes for the biodegradation of organic carbon. Anaerobic bacteria generally cannot function at DO concentrations greater than about 0.5 milligrams per liter (mg/L) and, hence, reductive dechlorination will not occur (USEPA, 1998). After depletion of DO, anaerobic microbes will use nitrate as an electron acceptor, followed by iron (III), sulfate, and finally carbon dioxide (methanogenesis). Each sequential reaction drives the ORP of the groundwater downward. Reductive dechlorination typically requires a redox state at least as anaerobic as sulfate reduction.

Excess concentrations of nitrate (greater than one mg/L) and sulfate (greater than 20 mg/L) may cause competitive exclusion of dechlorination. At the Facility, nitrate and sulfate concentrations in groundwater were generally measured to be lower than these potential competitive levels in the areas where chlorinated compounds were detected.

#### 3.2 Enhanced Bioremediation

Enhanced bioremediation is the process of increasing the rate of contaminant degradation through the addition of nutrients or additives that produce conditions supportive of the natural biodegradation process. HRC, a proprietary polylactate ester manufactured by Regenesis, Inc., is a viscous liquid specially formulated for slow release of lactic acid upon contact with water in the subsurface environment. Lactic acid can be metabolized by native microbes to hydrogen, which is a suitable electron donor for the reductive dechlorination process (Koenigsberg and Farone, 1999).

# 4.0 Pilot Test Implementation

#### 4.1 Pilot Area Selection

The pilot test area selected was at the Scrap Metal Recycling Dock at the Fabrication Operations Facility. Chlorinated aliphatic hydrocarbons compounds (TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and VC) were detected in the shallow groundwater at the Recycling Dock along with total petroleum hydrocarbons (TPH). The presence of cis-DCE and VC, compounds not know to have been historically used at the Facility, indicated that reductive dechlorination was naturally occurring in this area with potentially TPH being utilized as a carbon source.

The Scrap Metal Recycling Dock is located west of Building 27 (Figure 2-1) and consists of a concrete lined and curbed area approximately 250 feet long by 30 feet wide where aluminum, titanium, and other metal shavings and scrap from the manufacturing process are loaded into tractor trailers to be hauled off-site to a recycling company. The metal shavings contain cutting oil (currently water based) that is allowed to drain from the trailers into the curbed area prior to shipment. The cutting fluid is collected in a sump that is connected to a series of drain inlets in the concrete pad.

Monitoring Well MW3, located within the concrete curbed area in the Recycle Dock, was installed in July 2000 as part of the RFI. Groundwater from this well was sampled once (at installation) for TPH with a concentration of 1,700 micrograms per liter (µg/L) gasoline range TPH detected. Well MW3 was sampled for volatile organic compounds (VOCs) seven times during quarterly groundwater sampling prior to the pilot test implementation. PCE has never been detected in MW3. TCE concentrations detected in these seven samples ranged between 1,400 μg/L to 8,000 μg/L with an average concentration of approximately 4,000 μg/L. Cis-DCE concentrations ranged from 1,800 to 7,600 µg/L with an average concentration of approximately 3.700 µg/L. VC concentrations ranged from 32 µg/L to 130 µg/L with several non-detects at a detection limit of 100 µg/L. The average VC concentration detected was approximately 87 µg/L. The only other VOCs detected in MW3 were low concentrations of 1,1-dichloroethane (DCA), 1.1-DCE, and trans-DCE which were detected in some of the sampling events. The results of the pre-pilot test groundwater sampling for MW3 are summarized in Table 4-1 and presented graphically in Figure 4-1. Linear curve matching trend lines for each chlorinated compound indicated no increasing or decreasing trends during the two-year period. A complete summary of groundwater sampling analysis and copies of laboratory reports can be found in the Draft RFI report (MACTEC, 2003).

# 4.2 Pilot Test Design

An area approximately 625 square feet with monitoring well MW3 at the center was chosen as the pilot test area. An injection grid consisting of three rows of three injection borings set 10 feet apart with the middle row staggered 5 feet to the north was planned. The injection grid was located such that MW3 was approximately five feet downgradient (east) of the middle grid row. Due to the location of an underground fire protection water line, the downgradient row of injection borings was located approximately 15 feet east of the center row (Figure 4-2).

The average TCE, cis-DCE and VC concentrations detected in monitoring well MW3, along with additional competing electron acceptor values and additional demand factors such as competing microbial processes and hydrophobic sorbtion were used to calculate the appropriate HRC application rate. Based on the software program provided by Regenesis, an appropriate application rate of 6 pounds per foot in each injection boring was estimated.

In order to provide for monitoring of groundwater upgradient and downgradient of the pilot test area, two additional monitoring wells were installed at the Recycling Dock on June 10, 2002. Monitoring Well MW3A was installed 29 feet west (upgradient) of MW3 and MW3B was installed 24 feet east (downgradient) of MW3 (Figure 4-2). Construction of these two monitoring wells matched that of MW3 except that 15 feet of well screen was used in each instead of 10 feet. MW3A and MW3B were drilled to a depth of 20 feet bgs and completed with 15 feet of two-inch schedule 40 polyvinyl chloride (PVC), 0.001-inch slotted well screen and solid PVC riser to the surface. Sand pack was placed to two feet above the top of the well screen with a one foot bentonite seal on top of the sand pack. The wells were completed at the surface with flush mount well boxes with one-foot skirts set into concrete. Copies of the boring/monitoring well logs for MW3, MW3A, and MW3B are included as Appendix A.

Based on the design of the pilot test presented in the Pilot Test Work Plan, Boeing obtained an Underground Injection Control permit from the Missouri Department of Natural Resources Clean Water Commission for the pilot test project. A copy of the permit is included as Appendix B.

# 4.3 HRC Injection

PSA Environmental of Lee's Summit, Missouri conducted the HRC injection on July 19, 2002 under the direction of a MACTEC geologist. A truck mounted Geoprobe® hydraulic soil probing machine was used to install the injection borings using 1.5-inch diameter steel drive rod fitted with an expendable steel point. Each boring was driven to 19 feet bgs and the drill rod was retracted in approximately 1-foot intervals to 4 feet bgs. In two of the borings, a prototype injection drive rod head was used to allow injection in 1-foot intervals during the downward probing. Approximately six pounds of HRC was injected at each 1-foot interval for a total of 90

pounds per injection boring. The HRC material in 4-gallon buckets (30 pounds of HRC) was heated in a water bath to an approximate temperature of 120° Fahrenheit (°F) to increase the viscosity of the HRC. A Geoprobe® GS2000 pump was used to pump the HRC down the drive rods.

Following completion of HRC injection and removal of the drive rod, each boring was temporarily plugged with a four-foot section of 2x2 wood to keep the HRC from pushing back up the open borehole. After one to two hours, the fluid pressure dissipated, and the boreholes were capped with granular bentonite and the concrete surface patched.

# 4.4 Groundwater Monitoring

Groundwater samples were collected from the three monitoring wells (MW3, MW3A, and MW3B) the day prior to the HRC injection and monthly thereafter for the next year. A final round of groundwater sampling was conducted in January 2004, 19 months after the HRC injection. Groundwater samples were analyzed VOCs by EPA Method 8260.

Quarterly the groundwater samples were analyzed by the laboratory for 14 inorganic parameters: chloride; dissolved organic carbon (DOC); total organic carbon (TOC); ethane; ethene; free carbon dioxide; iron; dissolved iron; dissolved manganese; methane; nitrate; nitrite; sulfate; and sulfide. Additionally, the groundwater samples were analyzed quarterly for five metabolic acids: lactic acid, pyruvic acid, acetic acid, propionic acid, and butyric acid. These acids are indicators of the breakdown of the HRC. Copies of the laboratory reports and chain-of-custody documents for the January 2004 sampling event and the metabolic acid analysis are included in Appendix C. Copies of laboratory reports for the previous VOC analysis are included in the RFI (MACTEC, 2003).

Groundwater samples were collected using a peristaltic pump and dedicated tubing. When possible, the samples were collected using low flow sampling techniques (USEPA, 1996). If drawdown could not be stabilized in a well, the well was sampled after the removal of three well volumes of groundwater and the stabilization of field parameters. Field parameters measured were temperature, pH, conductivity, redox potential (ORP), DO, and ferrous iron.

Immediately upon collection, each sample was properly labeled to prevent misidentification and placed in a shipping container with sufficient ice or ice packs to maintain an internal temperature of four-degrees Celsius (°C) during transport to the laboratory. A completed chain-of-custody form was placed in each shipping container to accompany the samples to the laboratory. VOC and inorganic analysis were conducted by Environmental Science Corporation in Mt. Juliet, Tennessee. Metabolic acid analysis was conducted by Keystone Laboratories in Newton, Iowa.

# 4.5 Pilot Study Site Disturbance

On November 20, 2002 (154 days following HRC injection) the underground fire protection water line that runs through the Scrap Metal Recycling Dock failed, resulting in a release of an unknown volume of water. The water line runs through the pilot test area, between the center and east rows of injection points. The water line break occurred approximately 30 feet south of the pilot test area and was repaired within 24 hours by excavating an area approximately 20 feet long (north-south) by 10 feet wide (east-west). The monthly groundwater sampling of the pilot test wells was conducted on November 22, 2002.

#### 5.0 Results

A summary of the target VOC analytical results from the pilot test groundwater samples are presented in Table 5-1 and on Figure 5-1. Results of target VOC analytical molar data and molar ratio data are presented in Tables 5-2 and 5-3 and on Figure 5-2. A summary of inorganic analytical analysis is presented in Table 5-4 and on Figure 5-3. A summary of field parameter measurements is presented in Table 5-5 and on Figure 5-4. Results of metabolic acid analysis are presented in Table 5-6.

## 5.1 Upgradient Well

Monitoring Well MW3A was installed approximately 15 feet upgradient of the HRC injection grid. The results of VOC analysis indicate that chlorinated compound concentrations stayed the same or slightly increased over the 19-month pilot study. TCE concentrations ranged from 150  $\mu$ g/L to 290  $\mu$ g/L, cis-DCE concentrations ranged from 160  $\mu$ g/L to 460  $\mu$ g/L, trans-DCE concentrations ranged from less than one  $\mu$ g/L to 18  $\mu$ g/L, and VC concentrations ranged from less than one  $\mu$ g/L to 13  $\mu$ g/L.

Inorganic analysis and field parameter measurement indicated no discernible trends over the 19-month pilot test with the exception of a one-time drop in the ORP measurement corresponding with the break of the water line just south of the pilot test area. The ORP measurement returned the following month to the normal observed range.

# 5.2 VOC Analysis

The results of laboratory VOC analysis indicated that TCE concentrations declined 98 percent in MW3 by the first sampling event at 28 days post injection and were more than 99 percent lower through each of the subsequent 11 months. TCE concentration in MW3 at 19-months remained 98.7 percent lower than prior to injection. TCE concentrations declined 100 percent in MW3B by the first sampling event at 28 days post injection and remain below detection limit at 19-months.

The decline in TCE in MW3 was matched by an initial increase in cis-DCE over the first two months after injection. Three months after injection, cis-DCE concentrations declined significantly in MW3 and MW3B with a corresponding increase in vinyl chloride. The vinyl chloride concentration increased in MW3 though the eighth month of the pilot test (February 2003) and declined over the following eight months. The vinyl chloride concentration in MW3B declined each month starting with eighth month after injection.

#### 5.3 Molar Ratio

In an attempt to evaluate the degradation process molar ratio percentages of the chlorinated VOCs through time were assessed. Molar ratios between parent compound and daughter product should remain constant if no biodegradation is occurring. Molar ratio percentages provide a view of the relative proportions of an analyte to the sample as a whole. The total number of moles of organic compounds in a sample is the sum of the moles for each of the analytes (Table 5-2). In order to obtain the molar ratio percentage the concentration of the analyte is divided by its molecular weight to give the number of moles of that analyte in the sample. The molar ratio percentage is obtained by dividing the number of moles of an analyte by the total number of moles of organic compounds in the sample (Table 5-3). Only the targeted analytes (TCE, cis-DCE, and VC) were included in this molar ratio percentage evaluation.

Figure 5-2 presents a graphical presentation of the molar percentages for the analytical results. Monitoring Well MW3A, the upgradient well, shows relatively consistent molar ratio composition throughout the pilot test. Wells MW3 and MW3B both show a decrease in the percentage of TCE after the first 30 days and an increase in the percentage of VC between the third and ninth months post injection with a decrease in VC percentage throughout the remainder of the pilot test, indicative of enhanced reductive dechlorination.

## 5.4 Inorganic Analysis

A summary of inorganic analysis for the three wells in the pilot test in addition to one non-impacted monitoring well (MW9S) located nearby (approximately 150 feet away) is presented in Table 5-4. Five inorganic compounds useful in the evaluation of the reductive dechlorination stimulated by the injection of HRC at the pilot test area are graphed on Figure 5-3. Ethene was detected in MW3 in both the nine-month and 12-month sampling events and ethane was detected in the nine month sampling, corresponding with the observed decrease in VC, further evidence of the complete dechlorination of VC. The inorganic analysis observed suggests that the effect of the HRC in MW3 began to decline between nine and 12 months post injection as indicated by the slight increase of sulfate concentrations and the return of TOC concentrations to background levels. However, the results of VOC analysis and field parameter measurement indicate that conditions remain favorable for reductive dechlorination and that chlorinated compound degradation is continuing.

#### 5.5 Field Parameters

Field parameters measurements were collected each sampling event and are summarized in Table 5-5. The pH, specific conductivity, and ferrous iron content remained generally consistent in MW3 and MW3B over the course of the pilot test. The DO declined in both MW3 and MW3B

and remained below the pre-injection value with the exception for an increase in DO for approximately 30 days following the water line break. ORP declined in both MW3 and MW3B and remained below the pre-injection value for the duration of the pilot test, although the OPR levels did increase slightly in MW-3 and MW-3B following the water line break.

# 5.6 Metabolic Acid Analysis

HRC is a polylactic ester that breaks down into volatile acids: acetic, butyric, lactic, propionic, and pyruvic. Metabolic analysis indicated that acids were not detected in the four post injection quarterly sampling events. Additionally, lactic acid was not detected in a groundwater sample collected from well MW3 in October 2001. Lactic acid was detected in the sampling conducted on monitoring well MW3 immediately prior to the injection, this anomalous result may be the result of cross-contamination or laboratory error. The lack of detectable acid concentrations in the post injection sampling may indicate that HRC was quickly being completely broken down to levels below the laboratory detection limit.

#### 6.0 Conclusions

The results of the pilot test provide definitive evidence that reductive dechlorination is occurring within the test area and that the injection of HRC greatly accelerated the rate of chlorinated compound degradation.

- The dechlorination process was observed to go to completion with the reduction of TCE → cis-DCE → VC → ethene → ethane. Clear evidence that reductive dechlorination was going to completion was the detection of ethene and/or ethane in MW-3 in the two samples (March and June of 2003) analyzed for these constituents following the onset of vinyl chloride reduction in the well. Note that ethane and ethene was not detected in January 2004 but that the method detection limit was elevated (10 mg/L) for this analysis. Additionally, the low concentration of vinyl chloride present in MW-3B, would probably preclude the detection of ethane or ethene above the method detection limit of one mg/L.
- Additional evidence that complete dechlorination is occurring is that the vinyl chloride concentrations remained unchanged between the June 2003 and January 2004 sampling event in MW-3 while the cis-DCE concentration declined in this well by 37 percent. Since the vinyl chloride concentration did not change over this period, the vinyl chloride that was created by the reduction of the cis-DCE was offset by the dechlorination of vinyl chloride.
- Based on the reduction in TOC concentrations to pre-injection levels and the slight increase in sulfate observed in monitoring well MW3, the majority of HRC may have been consumed by the 12<sup>th</sup> month. However, the conditions for reductive dechlorination (low DO, redox potential, and limited competing electron donors) remain and that reductive dechlorination is still occurring as evidenced by the continued chlorinated compound degradation observed through the 19<sup>th</sup> month in both monitoring wells MW3 and MW3B.
- Groundwater immediately upgradient to the pilot area was unaffected by the pilot test. However, the VOC concentrations present in the upgradient well (MW3A) are an order of magnitude or more lower than the concentrations present prior to the pilot test in MW3 and continued reductive dechlorination is expected as the groundwater migrates into the anaerobic conditions of the pilot test area.
- The DO went up in monitoring wells MW-3 and MW-3B in the samples collected immediately after and 30 days after the water line break. This increase in DO is most likely the result of influence from the water line break and may have temporarily slowed the reductive dechlorination process. However, the DO levels in these two wells returned to low levels in the sampling conducted approximately 60 days after the line break and remained at favorably low levels for the remainder of the pilot test. Therefore, the water line break did not appear to have any long term effect on the results of the pilot test.

- The graphs of the detected VOC constituents provide indirect evidence that desorbtion of TCE from the soil below the groundwater table occurred for a period of time in monitoring well MW3. Given that TCE tends to degrade faster than DCE, if desorbtion is occurring, DCE will build up in the system over time. Initially, DCE concentrations rose in well MW3 over the first two month post injection, consistent with the observed rapid degradation of TCE in groundwater. The DCE concentrations declined significantly between the second and third month as the DCE was reduced at a faster rate than it was produced, TCE in groundwater had declined by more than 99 percent over this time. DCE concentrations started to go up beginning the fourth month through the 12<sup>th</sup> month indicating that DCE was being produced at a rate higher than it was degraded, most likely by the degradation of TCE desorbed from the soil. DCE concentrations fell between the 12<sup>th</sup> and 19<sup>th</sup> month indicating that TCE desorbtion was declining as TCE was removed from the soil.
- This trend of DCE build up was not observed in the downgradient well (MW3B) which indicates that desorbtion of TCE from the soil was not occurring at that location. Note that well MW3B is located outside of the source area (inside the curbed area at the Recycle Dock) and that screening of soil samples collected during the drilling of MW3B did indicate the presence of organic vapors in the soil.

#### 7.0 References

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**Tables** 

Table 4-1 Summary of Laboratory Pre-Pilot Test Target VOC Data (μg/L), Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date:	06/19/02									
	Sampling Date	07/28/2000	01/10/2001	05/09/2001	07/24/2001	10/25/2001	03/06/2002	06/18/2002			
Well	Days Since Injection	-691	-525	-406	-330	-237	-105	-1			
ID	Parameter	Results (µg/L)									
	PCE	<100	<5	<100	<1	<25	<1	<100			
	TCE	1,700	6,900	3,500	2,700	8,000	1,400	3,900			
MW3	cis-1,2-DCE	2,100*	6,000	2,600	2,600	7,600	1,800	3,300			
	trans-1,2-DCE	NA	91	<100	62	260	67	<100			
	VC	32	120	<100	81	130	75	<100			
	Total VOC	1,732	13,111	6,100	5,443	15,990	3,342	7,200			

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Notes:

PCE - Tetrachloroethene

TCE - Trichloroethene cis-1,2-DCE - cis-1,2-Dichloroethene

VC - Vinyl chloride

\* - Result of total 1,2-DCE analysis

VOC - Volatile Organic Compound

NA - Not analyzed

< - Not detected above the indicated concentration

 $\mu$ g/L - micrograms per liter

Table 5-1 Summary of Laboratory Target VOC Data (µg/L), Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date:	06/19/2002														
XX/ II	Sampling Date	06/18/2002	07/18/2002	08/15/2002	09/23/2002	10/15/2002	11/22/2002	12/16/2002	01/20/2003	02/20/2003	03/17/2003	04/17/2003	05/19/2003	06/18/2003	01/14/2004	D.
Well ID	Days Since Injection	-1	29	57	96	118	156	180	215	246	271	302	334	364	574	Percent
110	Parameter							Results (µ	.g/L)	= = =	Gradien : St					Change
MW3A	PCE TCE cis-1,2-DCE trans-1,2-DCE VC Total VOC	<1 190 160 9.8 4.9	<1 220 240 12 5.9 477.9	<1 240 270 14 5.3 529.3	<1 150 200 12 4.8 366.8	<5 170 260 10 6	<1 190 290 12 7.5	<10 230 320 14 <10	<1 240 340 17 6.7 603.7	<1 220 290 12 9.3 519.3	<1 220 270 14 7.1 497.1	<1 150 220 11 8.9 389.9	<1 220 320 18 8.7 566.7	<1 260 360 18 9.9	<1 290 460 <1 13	0% 52.6% 187.5% -100.0% 165.3% 109.2%
MW3	PCE TCE cis-1,2-DCE trans-1,2-DCE VC Total VOC	<100 3,900 3,300 <100 <100 7,200	<50 210 3,800 73 <50 4,083	<50 51 4,900 110 84 5,145	<1 8 1,300 34 440	<5 <5 2,200 44 1,400 3,644	<25 33 2,100 39 1,100 3,272	<5 5.8 1,600 47 1,300 2,953	<1 5.2 2,300 54 1,600 3,959	<1 9.7 2,700 59 2,700 5,410	<1 6.4 2,700 53 2,100 4,806	<50 <50 2,900 <50 1,600	<5 9.1 3,600 77 1,400 5,086	<1 7.3 4,100 68 1,000 5,175	<1 34.0 2,600 100 1,000	0% -98.7% -21.2% 0.0% 3900% -48.1%
MW3B	PCE TCE cis-1,2-DCE trans-1,2-DCE VC Total VOC	<1 8.5 130 2.7 1.2	<1 2.1 100 1.7 <1 103.8	<2 <2 86 <2 <2 <2	<1 <1 65 1.5 2.5	<1 <1 53 1.5 15 69.5	<1 1.1 30 1.4 15	27 1.4 11 39.4	<1 <1 27 1.5 15 43.5	<1 <1 19 <1 12	<1 <1 15 1.1 7.7 22.7	<1 <1 13 <1 6.4	<1 <1 16 <1 5.8 21.8	<1 <1 16 1.1 4.2	<1 <1 6.2 <1 1.8	0% -100.0% -95.2% -100.0% 50.0% -94.4% MACTEC, 2004

PCE - Tetrachloroethene

TCE - Trichloroethene

cis-1,2-DCE - cis-1,2-Dichloroethene

trans-1,2-DCE - trans-1,2-Dichloroethene

VC - Vinyl chloride

VOC - Volatile Organic Compound

μg/L - micrograms per liter

< - Not detected above the indicated concentration

02/06/2004

02/06/2004

Table 5-2 Summary of Target VOC Molar Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	In	jection Date:	06/19/02													
	Sa	mpling Date	06/18/02	07/18/02	08/15/02	09/23/02	10/15/02	11/22/02	12/16/02	01/20/03	02/20/03	03/17/03	04/17/2003	05/19/2003	06/18/2003	01/14/2004
Well	Days Sir	nce Injection	-1	29	57	96	118	156	180	215	246	271	302	334	364	574
ID	Parameter	mol. Wt. (g/mol)							Result	s (μmol/L)						
	PCE TCE	165.83 131.39	0.0 1.4	0.0 1.7	0.0 1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MW3A	cis-1,2-DCE VC	96.94 62.50	1.7 0.1	2.5 0.1	2.8 0.1	2.1	2.7	3.0	3.3	3.5 0.1	3.0	2.8	2.3	3.3	3.7 0.2	4.7 0.2
		Total	3.2	4.2	4.7	3.3	4.1	4.6	5.1	5.4	4.8	4.6	3.6	5.1	5.9	7.2
MW3	PCE TCE cis-1,2-DCE VC	165.83 131.39 96.94 62.50	0.0 29.7 34.0 0.0	0.0 1.6 39.2 0.0 40.8	0.0 0.4 50.5 1.3 52.3	0.0 0.1 13.4 7.0 20.5	0.0 0.0 22.7 22.4 45.1	0.0 0.3 21.7 17.6 39.5	0.0 0.0 16.5 20.8	0.0 0.0 23.7 25.6 49.4	0.0 0.1 27.9 43.2 71.1	0.0 0.0 27.9 33.6 61.5	0.0 0.0 29.9 25.6 55.5	0.0 0.1 37.1 22.4 59.6	0.0 0.1 42.3 16.0 58.3	0.0 0.3 26.8 16.0 43.1
MW3B	PCE TCE cis-1,2-DCE VC	165.83 131.39 96.94 62.50 <b>Total</b>	0.0 0.1 1.3 0.0	0.0 0.0 1.0 0.0	0.0 0.0 0.9 0.0	0.0 0.0 0.7 0.0	0.0 0.0 0.5 0.2	0.0 0.0 0.3 0.2	0.0 0.0 0.3 0.1	0.0 0.0 0.3 0.2	0.0 0.0 0.2 0.1	0.0 0.0 0.2 0.1	0.0 0.0 0.1 0.1	0.0 0.0 0.2 0.1	0.0 0.0 0.2 0.0	0.0 0.0 0.1 0.0 0.1
	N.	•	•												N	IACTEC, 2004

cis-1,2-DCE - cis-1,2-Dichloroethene

g/mol - grams per mole  $\mu$ mol/L - micromole per liter

PCE - Tetrachloroethene

TCE - Trichloroethene

VC - Vinyl chloride

a. - For those results less than the laboratory reporting limit, numeric zeros were listed as results and were used for graphing purposes. Detection limits are subject to variation due to sample matrix interference and sample dilution.

P:\S100098\HRC\PilotTestReportTables.xls

Table 5-3 Summary of Target VOC Molar Percentage Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Inj	Sampling Date 06/19/0 Days Since Injection											,			
	Sai	mpling Date	06/18/02	07/18/02	08/15/02	09/23/02	10/15/02	11/22/02	12/16/02	01/20/03	02/20/03	03/17/03	04/17/03	05/19/03	06/18/03	01/14/04
Well	Days Sin	ce Injection	-1	29	57	96	118	156	180	215	246	271	302	334	364	574
ID	Parameter	mol. Wt. (g/mol)						Perce	ent (%) of To	otal Moles						
	PCE TCE	165.83 131.39	0.00% 45.55%	0.00% 39.45%	0.00% 38.89%	0.00% 34.79%	0.00% 31.78%	0.00% 31.73%	0.00% 34.65%	0.00% 33.57%	0.00% 34.78%	0.00% 36.61%	0.00% 32.13%	0.00% 32.74%	0.00% 33.82%	0.00% 30.83%
MW3A	cis-1,2-DCE	96.94	51.98%	58.33%	59.30%	62.87%	65.87%	65.64%	65.35%	64.46%	62.13%	60.90%	63.86%	64.54%	63.47%	66.27%
	VC	62.50 Total	2.47% 100.00%	2.22% 100.00%	1.81% 100.00%	2.34% 100.00%	2.36% 100.00%	2.63% 100.00%	0.00%	1.97% 100.00%	3.09% 100.00%	2.48% 100.00%	4.01% 100.00%	2.72% 100.00%	2.71% 100.00%	2.91% 100.00%
	PCE TCE	165.83 131.39	0.00% 46.58%	0.00% 3.92%	0.00% 0.74%	0.00% 0.30%	0.00%	0.00% 0.64%	0.00% 0.12%	0.00% 0.08%	0.00% 0.10%	0.00% 0.08%	0.00% 0.00%	0.00% 0.12%	0.00% 0.10%	0.00% 0.60%
MW3	cis-1,2-DCE VC	96.94 62.50	53.42%	96.08% 0.00%	96.69% 2.57%	65.38% 34.32%	50.32%	54.82% 44.54%	44.19% 55.69%	48.06% 51.86%	39.16% 60.74%	45.29% 54.63%	53.89%	62.30% 37.58%	72.48% 27.42%	62.26% 37.14%
		Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
MW3B	PCE TCE cis-1,2-DCE VC	165.83 131.39 96.94 62.50 Total	0.00% 4.54% 94.11% 1.35% 100.00%	0.00% 1.53% 98.47% 0.00% 100.00%	0.00% 0.00% 100.00% 0.00%	0.00% 0.00% 96.30% 3.70% 100.00%	0.00% 0.00% 77.94% 22.06% 100.00%	0.00% 1.77% 65.49% 32.74% 100.00%	0.00% 0.00% 71.05% 28.95% 100.00%	0.00% 0.00% 64.29% 35.71% 100.00%	0.00% 0.00% 61.29% 38.71% 100.00%	0.00% 0.00% 66.08% 33.92% 100.00%	0.00% 0.00% 67.01% 32.99% 100.00%	0.00% 0.00% 73.39% 26.61% 100.00%	0.00% 0.00% 79.21% 20.79% 100.00%	0.00% 0.00% 77.50% 22.50% 100.00%
															the same of the sa	CTEC, 2004

PCE - Tetrachloroethene

TCE - Trichloroethene

cis-1,2-DCE - cis-1,2-Dichloroethene

VC - Vinyl chloride

g/mol - Grams per mole

mol. Wt. - Molecular weight

a. - For those results less than the laboratory reporting limit, numeric zeros were listed
as results and were used for graphing purposes. Detection limits are subject to
variation due to sample matrix interference and sample dilution.

2/4/2004

P-\S100098\HRC\PilotTestReportTables

Table 5-4 Summary of Laboratory Groundwater Quality Parameter Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date:	06/19/2002	05/09/2001	07/24/2001	10/25/2001	03/06/2002	06/18/2002	08/15/2002	12/16/2002	03/17/2003	06/18/2003	01/14/2004
Well	Sampling Date‡ Days Since Injection	01/10/2001	-406	-330	-237	-105	-1	57	180	271	364	574
ID		-525	100				Results (mg/	1)				De le Principal
	Parameter				T		Results (IIIg)					
	Chloride	NI	NI	NI	NI	NI	480	640	610	550	690	690
	DOC	NI	NI	NI	NI	NI	2.3	1.1	1.7	1.0	1.2	2.0
	TOC	NI	NI	NI	NI	NI	2.2	1.1	1.6	1.4	1.2	1.4
	Ethene	NI	NI	NI	NI	NI	<1	<1	<1	<1 <1	<1 <1	<10
	Ethane	NI	NI	NI	NI	NI	<1	<1	<1 <1	<1	<1	<10
	Methane	NI	NI	NI	NI	NI	<1	<1 1.3	0.73	0.84	0.8	0.9
MW3A	Manganese (disolved)	NI	NI	NI	NI NI	NI NI	0.89	74	0.037	0.069	0.053	<0.05
	Iron (total)	NI	NI	NI NI	NI	NI	<0.02	0.22	<0.02	<0.05	< 0.05	0.05
	Iron (dissolved)	NI	NI NI	NI NI	NI NI	NI	0.48	<0.1	0.288	<0.1	0.19	<0.
	Nitrate (as N)	NI	NI	NI	NI	NI	<0.1	<1.0	<2.5	<0.1	<0.1	<0.
	Nitrite (as N)	NI NI	NI	NI	NI	NI	85	95	95.9	95	92	9
	Sulfate	NI	NI	NI	NI	NI	<0.10	<0.02	< 0.02	< 0.05	< 0.05	<0.0
	Sulfide Free Carbon Dioxide	NI	NI	NI	NI	NI	150	120	160	170	130	18
	Free Carbon Dioxide										520	40
	Chloride	417	395	460	490	580	450	430	590 2.3	530 1.6	530 1.4	48
	DOC	<1	1.8	1.6	1	<1	1.8	7.1	2.5	2.1	<1.0	1.
	TOC	1	1.85	1.7	1.2	1	1.6	7.2	<1	1.3	7.9	<1
	Ethene	NA	NA	NA	NA	<1 <1	<1 <1	<1	<1	1.3	<1	<1
	Ethane	NA	NA	NA	NA	<1	<1	<1	<1	78	<1	1.
	Methane	NA	NA	NA	NA NA	NA	2.1	1.8	1.9	2.0	1.9	2.
MW3	Manganese (disolved)	NA	NA	NA NA	5.5	5.6	4.9	5.6	5.5	5.8	5.3	5.
	Iron (total)	3.4 NA	NA NA	NA	NA	NA	<0.02	<0.02	0.051	0.78	1.1	0.
	Iron (dissolved)	<0.03	<0.1	0.2	<0.1	<1	<0.1	<0.1	<0.1	<0.1	< 0.1	<0.
	Nitrate (as N)	<0.03	<0.1	<0.1	<0.1	<1	<0.1	<1.0	<2.5	< 0.1	< 0.1	<0.
	Nitrite (as N)	73.9	80	80	86	87	87	30	22.6	28	39	4
	Sulfate Sulfide	NA NA	NA	NA	NA	NA	<0.1	< 0.02	< 0.02	< 0.05	< 0.05	0.07
	Free Carbon Dioxide	NA	NA	NA	NA	100	150	110	130	110	120	14
	Chloride	NI	NI	NI	NI	NI	840	870	830	870	1,000	1,400
	DOC	NI	NI	NI	NI	NI	1.6	1.3	1.6	1.2	<1	1.
	TOC	NI	NI	NI	NI	NI	1.4	<1	1.4	1.1	<1	<
	Ethene	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<1
	Ethane	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	<1
	Methane	NI	NI	NI	NI	NI	<1	<1	<1	<1	<1	
MW3B	Manganese (disolved)	NI	NI	NI	NI	NI	5.5		4.9	5.3	5.2	6
111 11015	Iron (total)	NI	NI	NI	NI	NI	5.7	12	8.3	11	12 7.9	
	Iron (dissolved)	NI	NI	NI	NI	NI	0.63		0.8	5.4	<0.1	<0
	Nitrate (as N)	NI	NI	NI	NI	NI	<0.1	<0.1	<0.1	<0.1	<0.1	<0
	Nitrite (as N)	NI	NI	NI	NI	NI	<1.0	<1.0	<2.5 29.1	<0.5	34	<b>(</b> 0
	Sulfate	NI	NI	NI	NI	NI	38	<0.02	<0.02	<0.05	<0.05	<0.
	Sulfide	NI	NI	NI	NI NI	NI NI	<0.10 <b>89</b>		110	88	77	1
	Free Carbon Dioxide	NI	NI	NI	NI							
	Chloride	NS	NS	NS	NS	NS	5,200	5,200	5,500	5,200	5,400	1
	DOC	NS	NS	NS	NS	NS	<1	1.4	1.6	1.4	1.3	1
	TOC	NS	NS	NS	NS	NS	<1	1.5			<1	
	Ethene	NS	NS	NS	NS	NS	<1		<1	<1 <1	<1 <1	
	Ethane	NS	NS	NS	NS	NS	<1				<1	
	Methane	NS	NS	NS	NS	NS NS	<1 NA	20000	<1 NA	<1 6.4	4.9	
MW9S	Manganese (disolved)	NS	NS	NS	NS	NS NC	NA NA			18	17	
	Iron (total)	NS	NS	NS NS	NS NC	NS NS	NA NA				0.3	
	Iron (dissolved)	NS	NS NC	NS NS	NS NS	NS NS	NA <1		0.25		<0.4	
	Nitrate (as N)	NS NS	NS NS	NS NS	NS NS	NS NS	<1				<10	
	Nitrite (as N)	NS NS	NS NS	NS NS	NS NS	NS NS	140					
	Sulfate	NS NS	NS NS	NS NS	NS	NS	NA NA				< 0.05	
	Sulfide	NS NS	NS NS	NS NS	NS NS	NS	250				180	
	Free Carbon Dioxide	IND	CVI	140	140	110	200					MACTEC, 2

DOC - Dissolved organic carbon TOC - Total organic carbon N - Nitrogen

< - Not detected above the indicated concentration

NI - Well not installed

NA - Not analyzed

mg/L - milligrams per liter

\*\* Samples may be collected on two consecutive days. The first day of sampling is used for the sampling date on this table and for the dates plotted on the attached figures.

Table 5-5 Summary of Field Groundwater Quality Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date:	06/19/2002						1011 (1000)	04/00/0000	02/20/2002	03/17/2003	04/17/2003	05/19/2003	06/18/2003	01/14/2004	
	Collection Date‡	06/18/2002	07/18/2002	08/15/2002	09/23/2002	10/15/2002	11/22/2002	12/16/2002	01/20/2003	02/20/2003		302	334	364	574	Optimum
Well	Days Since Injection	-1	29	57	96	118	156	180	215	246	2/1	302	334	301		Value
ID	Parameter							Results							606	5 · - W - (
	Final pH	7.03	6.74	6.71	6.66	6.74	6.79	6.79	6.63	6.87	6.76	6.75	<b>6.76</b> 2,860	<b>6.87</b> 2,850	<b>6.06</b> 2,990	5 < pH < 9 NA
	Final Conductivity (uS)	2,380	2,510	2,810	2,830	2,720	2,840	2,240	2,840	2,650	2,840	2,820 14.9	17.9	20.5	14.3	>20
	Final Temperature (C)	19.4	20.2	21.7	22.7	20.5	17.5	15.3	12.9	12.2 <b>0.2</b>	14.2 <b>0.6</b>	0.25	0.0	0.0	0.65	< 0.5
MW3A	Final Dissolved Oxygen (mg/L)	4.12	0	0.34	0.87	0.12	0.79	0.89	0.0 115	100	46	60	47	18	26	<-100
	Final ORP (mvolts)	64		11	-14	74	-185	-7	0.0	0.0	0.4	0.4	0.4	0.2	0.0	>1
	Ferrous (Fe2+) Iron (mg/L)	0.4			NS	0.0	0.0	2.5	2.25	0.0	3.25	4.5	2.5	3.5	2.5	
	Total Volume Purged (gallons)	8.0	9.0	9	13.5	3	3					(05	6.83	6.88	7.34	5 < pH <
	Final pH	6.88	6.80	6.75	6.72	6.78	6.81	6.81	6.76	6.78		<b>6.95</b> 2,490	2,490	2,420	2,400	NA
	Final Conductivity (uS)	2,450	2,360	2,270	2,450	2,330	2,260	1,930	2,470	2,490	2,520 15.3	15.1	18.4	20.9	16.8	>20
	Final Temperature (C)	20.1	22.3		22.0	22.0	20.1	16.3	15.4	0.07				0.0	0.25	< 0.5
MW3	Final Dissolved Oxygen (mg/L)	0.34		0.2	0.52	0.0	1.28	1.44 -151	0.0 -166				-244	-183	-206	< -100
	Final ORP (mvolts)	-40	-209		-185	-237	-305	2.2	3.4				3.0	3.4	NS	>1
	Ferrous (Fe2+) Iron (mg/L)	3.2			NS	2.6	7.5	1.5	2.5			2.5	1.5	2.0	7.5	
	Total Volume Purged (gallons)	2	1.3	7	1.5	2.5	7.5	1.5				6.53	6.7	6.63	7.6	5 < pH ·
	Final pH	6.71	6.59	6.54	6.45	6.55	6.56	6.53	6.61			3,600	3,630		4,290	NA
	Final Conductivity (uS)	3,400	3,320	3,470	3,550	3,410	3,310	2,580	3,390	3,220	70.00	15.3	18.8			The State of the S
	Final Temperature (C)	24.5	21.4			22.6	18.6	16.6	14.8							THE RESERVE OF THE PARTY OF THE
MW3B	Final Dissolved Oxygen (mg/L)	2.25	0.0				0.45	1.11	0.0 -28		-43	-23				< -10
	Final ORP (mvolts)	23						-99 <b>2.8</b>	2.6		2	2.8				>1
	Ferrous (Fe2+) Iron (mg/L)	2.4				2.6	2.4 3.25	2.5	1.75							Barrier Branch Control
	Total Volume Purged (gallons)	2.8	8.8	3 9	1.5*	3	3.25	2.3	1.75	2.23	21110				N	MACTEC, 2

C - Degrees Celsius

uS - microsiemens

\* - Volume not measured - estimated purge volume.

mvolts - millivolts NS - Not sampled

NA - Not applicable

mg/L - milligrams per liter

ORP - Oxidation Reduction Potential

Bold - Indicates result in optimum value range

‡ Samples may be collected on two consecutive days. The first day of sampling is used for the sampling date on this table and for the dates plotted on the attached figures.

Table 5-6 Summary of Metabolic Acid Analysis Data, Enhanced Bioremediation Pilot Test, Boeing Tract 1 Hazelwood, Missouri

	Injection Date: 6	5/19/2002					
	Sampling Date <sup>a</sup>	10/25/2001	6/18/2002	9/23/2002	12/16/2002	3/18/2003	6/18/2003
Well	Days Since Injection	-236	-1	96	180	272	364
ID	Parameter			Results	(mg/L)		
	Acetic Acid	NI	<1	<1	<1	<1	<
MANIOA	Butyric Acid	NI	<1	<1	<1	<1	<
MW3A	Lactic Acid	NI	<1	<1	<1	<1	<
	Propionic Acid	NI	<1	<1	<1	<1	<
	Pyruvic Acid	NI	<0.1	<0.1	<0.1	<0.1	<0.
	Acetic Acid	NA	<1	<1	<1	<1	<
MINO	Butyric Acid	NA	<1	<1	<1	<1	<
MW3	Lactic Acid	<1	26.6	<1	<1	<1	<
	Propionic Acid	NA	<1	<1	<1	<1	<
	Pyruvic Acid	NA	<0.1	<0.1	<0.1	<0.1	<0.
	Acetic Acid	NI	<1	<1	<2	<1	<
MW3B	Butyric Acid	NI	<1	<1	<2	272  <1 <1 <1 <0.1 <1 <1 <1 <1 <1 <1 <1 <1 <1 <1 <1 <1 <1	<
IVI VV 3B	Lactic Acid	NI	<1	<1	<2	<1	<
	Propionic Acid	NI	<1	<1	<2	272  <1 <1 <1 <0.1 <1 <1 <1 <0.1 <1 <1 <1 <1 <1 <1 <1 <1 <1 <1 <1 <1 <1	<
	Pyruvic Acid	NI	< 0.1	< 0.1	< 0.2	< 0.1	<0.

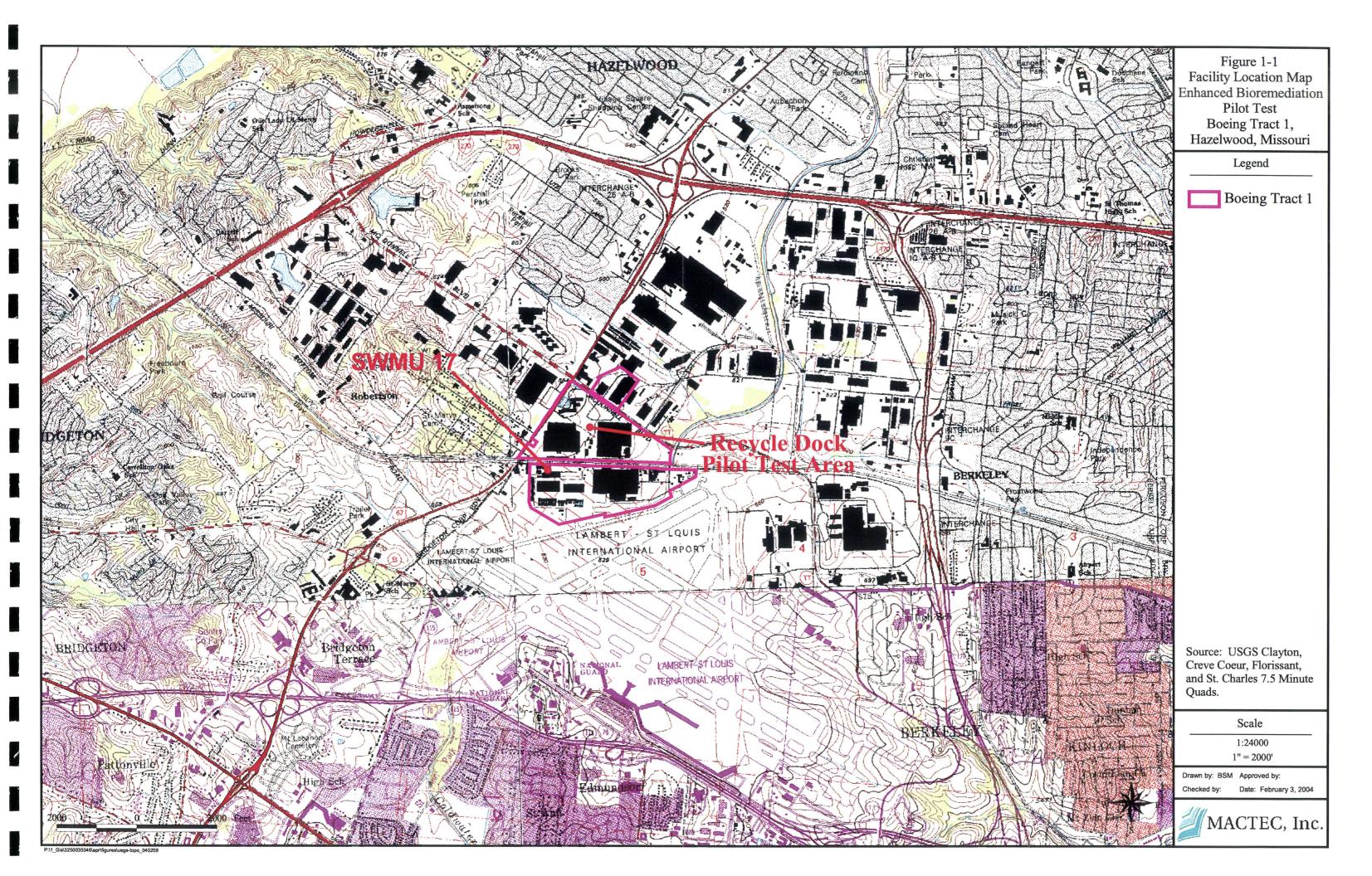
MACTEC, 2004

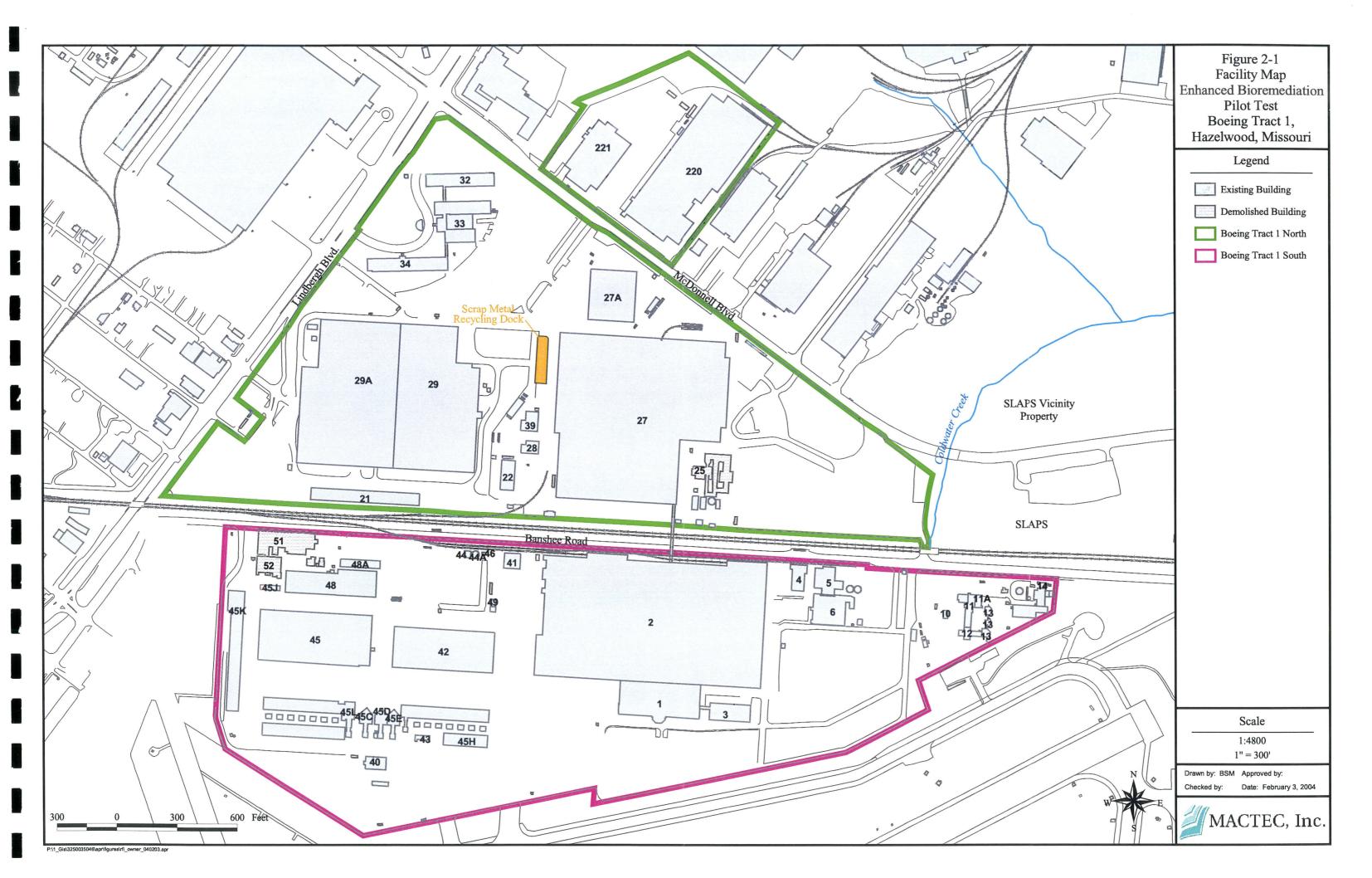
#### Notes:

- < Not detected above the indicated concentration
- NI Well not installed
- NA Not analyzed
- a. Samples may be collected on seperate days. The date that MW3 was sampled is used for the sampling date on this table and for the dates plotted on the attached figures.

mg/L - milligrams per liter

**Figures** 





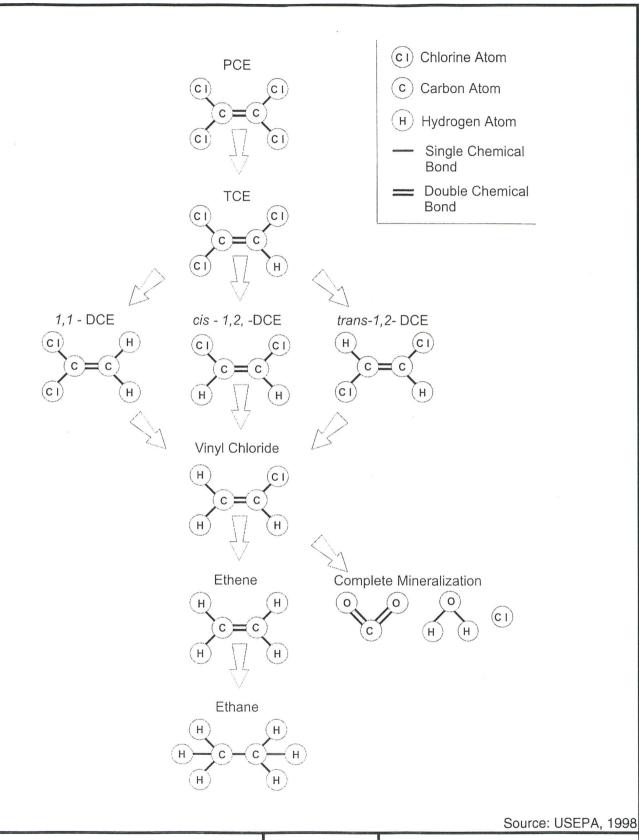


Figure 3-1
Reduction Dehalogenation of Chlorinated
Ethenes

**Enhanced Bioremediation Pilot Test** 

**Boeing Tract 1** 

Hazelwood, Missouri

Drawn by: DLB

Checked by: LMS

Approved by:

Date: 2/4/2004



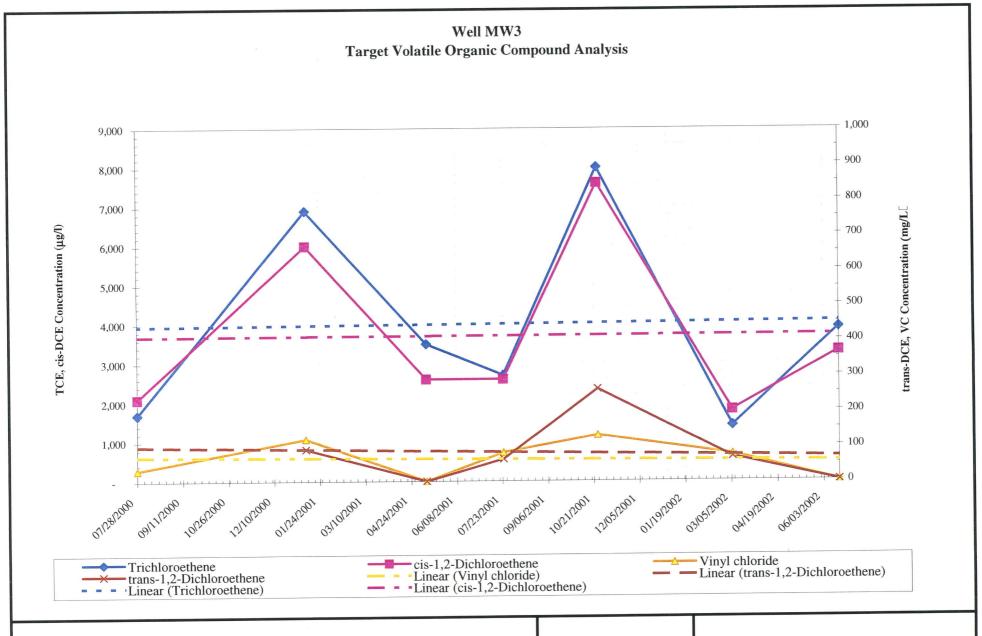
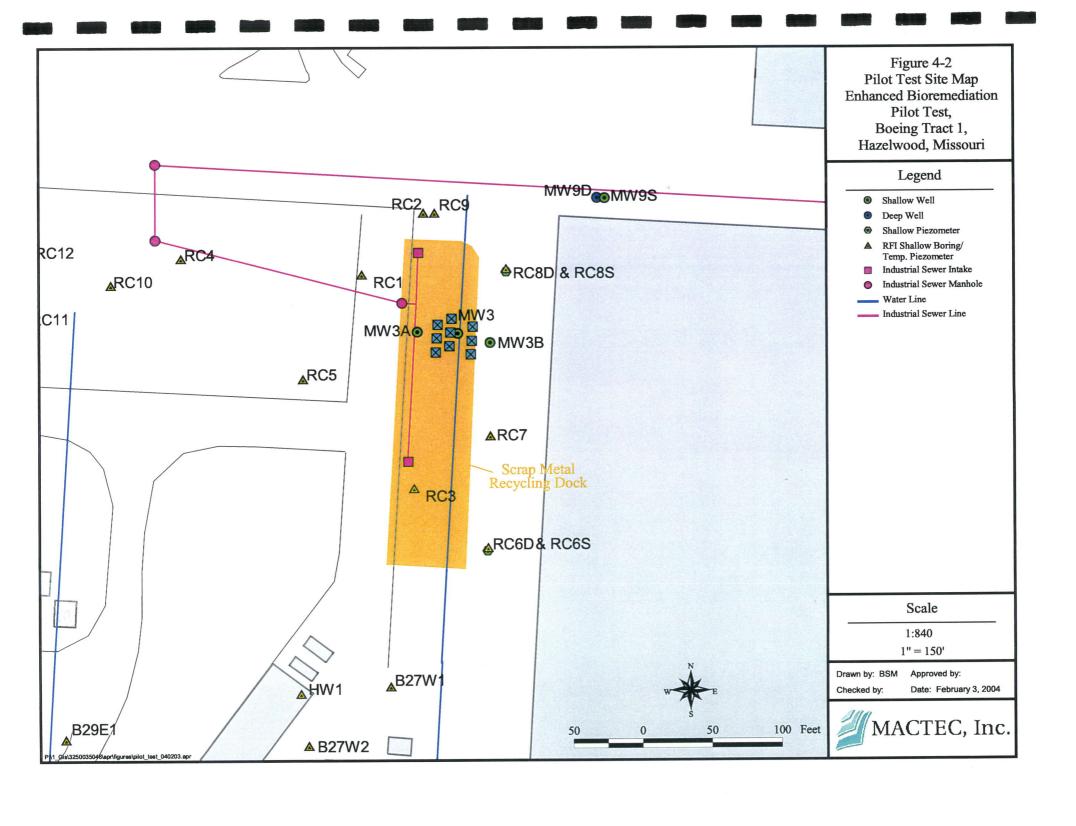
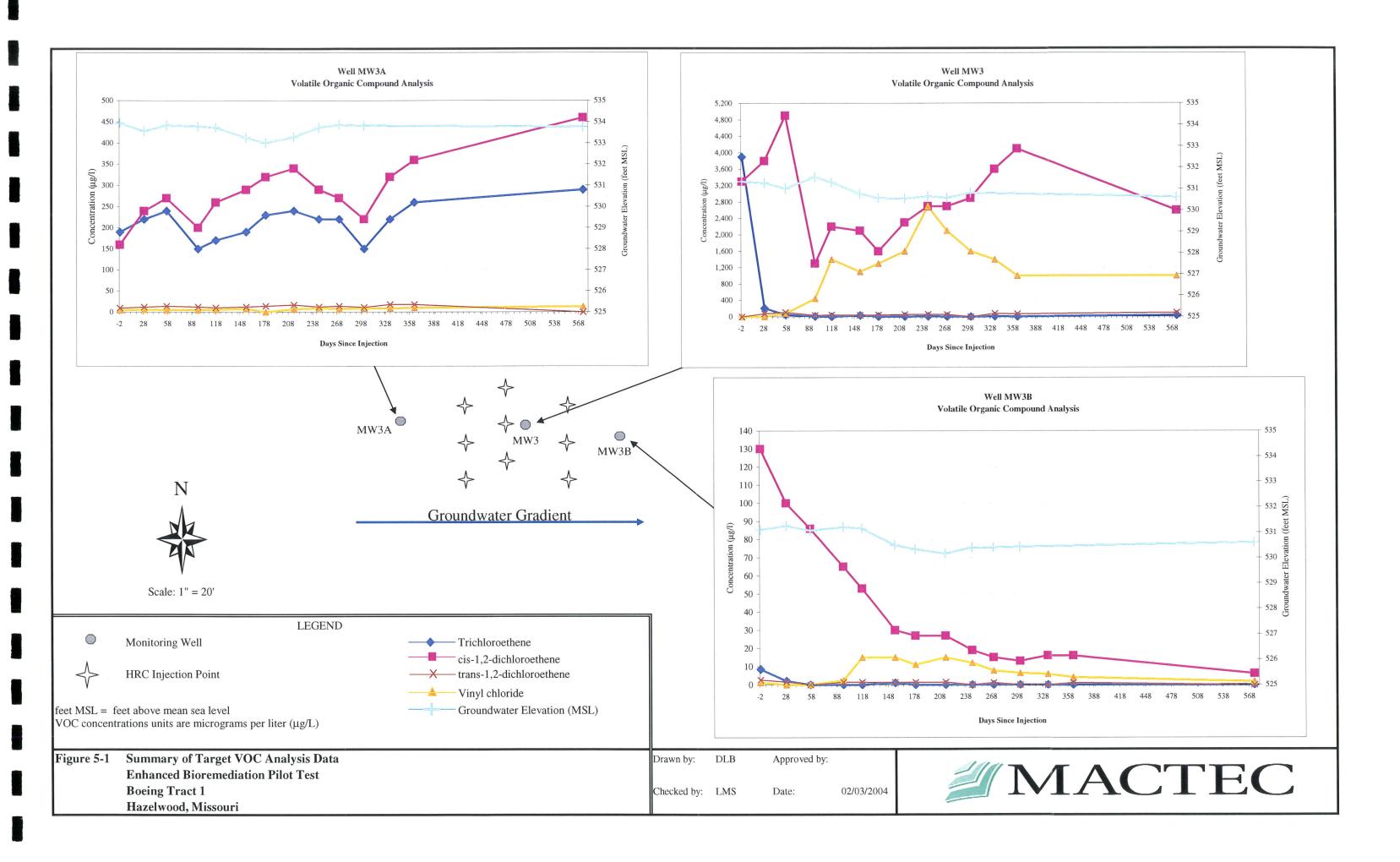


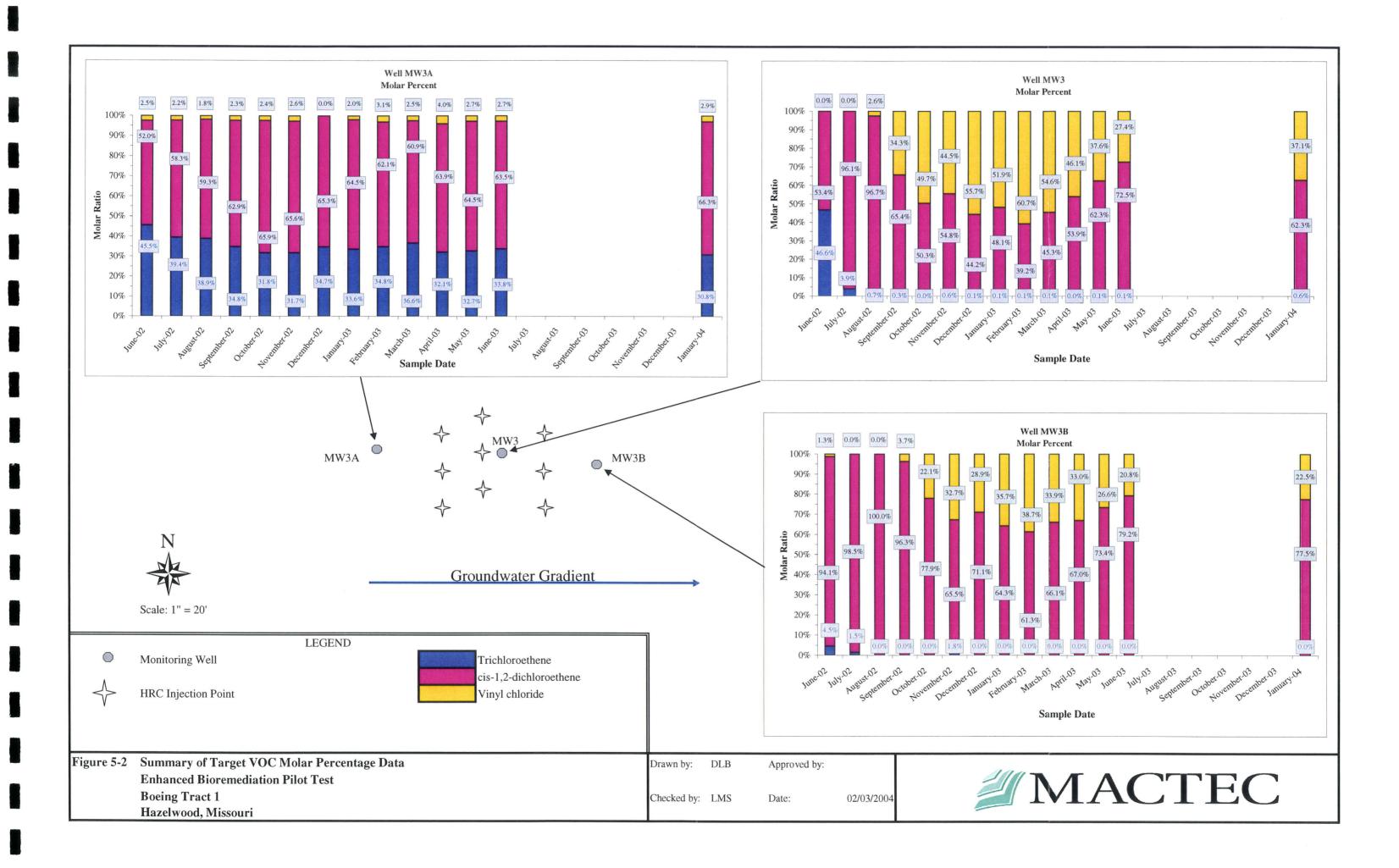
Figure 4-1 Summary of Pre-Pilot Test Target VOC Analysis from MW3
Enhanced Bioremediation Pilot Test
Boeing Tract 1
Hazelwood, Missouri

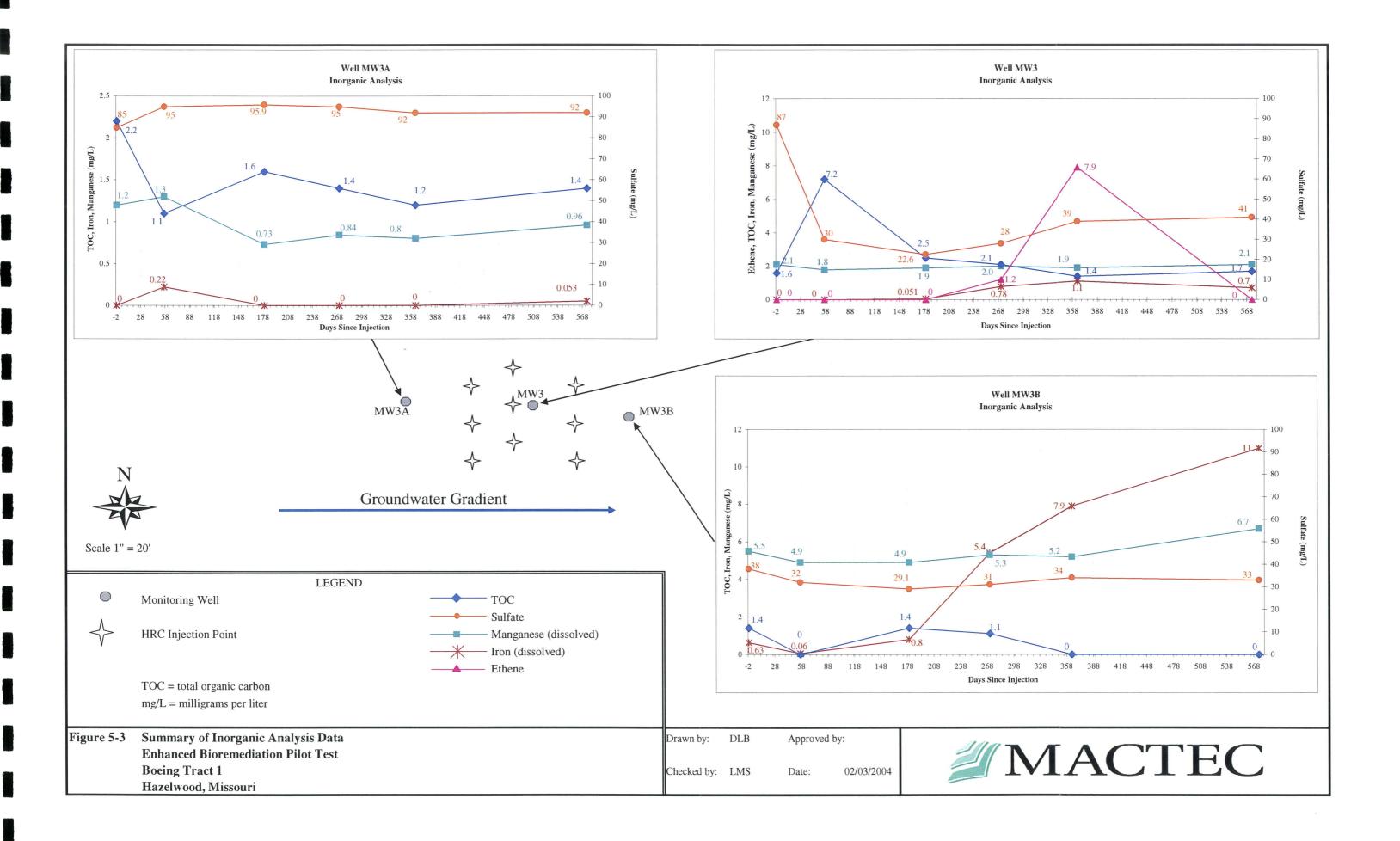
Drawn by: DLB
Checked by: LMS
Approved by:
Date: 2/4/2004

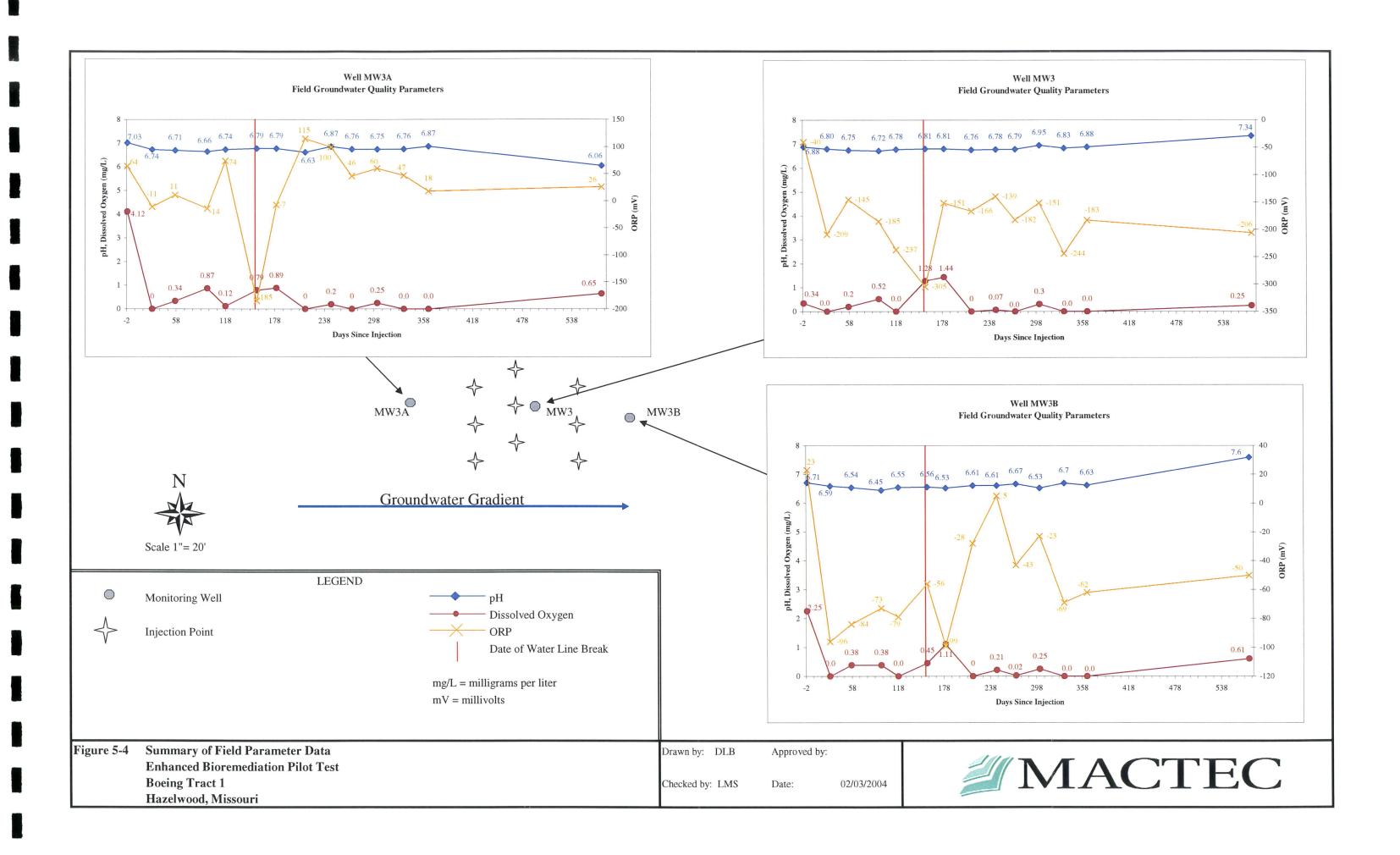












# Appendix A

**Boring and Monitoring Well Logs** 

200	N /T A				<b>10.</b>			Client:	Boeing	Location:	Tract 1 North	Boring # MW3
	WA	CTE			Well Lo	g		Logged B	Ву:	D. Brinkley		Project # 510098
Field	Locati	on:						Drilled By	y:	Roberts En	vironmental	Date:
!								Drilling M	lethod:	Hollow Ster	n Auger	07/19/2000
	M.							Sampling	Method:	5' CME Cor	ntinuous	Sheet:
	V							Hole Diar	meter:	8.5 inch		1 of 1
		ion	ery	Analys	ses/Tests			Well Con	struction:	2" sch 40 P	VC, 0.001" slot	screen
	go.	-ocat	ecov				loqu	Screen Ir	nterval:	19.7	to 9.	7
Depth (ft)	Graphic Log	Sampler Location	Sample Recovery	٦	Lab Sample ID		USCS Symbol	Sand Pad	ck:	19.7	to 7.	5
Dept	Grap	Sam	Sam	PID (ppm)	Lab ID	Time	osn	Seal:		8 ft.	to 2	ft.
		\ /						Descripti			concrete pave	ement. No
		$\setminus$ /							rock b	ase below cond	crete.	
-		$  \setminus /  $		3	MW-3-2				silty cl	iay, moderate p	lasticity, grayish	1
		V					cl		olive,	soft, slightly mo	oist, no odor	
		$  / \lambda  $	36"									
		// \l				1505						
5				3								
		***************************************										
_		$ \setminus $					cl		Silty	elay high plastic	city, ducky yello	wish
		\/		2			Ci				n staining, no o	
		<b>.</b>										
-		<i> </i>	36"									
-		I/ \	30									
10				5		1515						
		$\Lambda$					ci		Silty	clav. gravish oliv	ve, moderate to	hiah
		$  \setminus /  $		4						city, moist, stiff,		
		$  \ \ \ \  $			[	ļ						
_	1											
		$  / \rangle  $										
	}	$   /   \rangle$	60"			-						
15	†	$V \setminus$				1530						
	]	$\setminus$										
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<b> </b>	†	$  / \rangle$					cl		as ab	ove, very stiff,	wet	
		$ / \rangle$					-					
20		$V_{\perp}$	60"	2		1540						

	ΜA	CT	EC		Well Lo	g		Client: Boeing	Location:	Tract 1 North	Boring # MW3A
								Logged By:	D. Brinkley		Project # 510098
Field	Locat	ion:						Drilled By:	Roberts En	vironmental	Date:
								Drilling Method:	Hollow Ster	n Auger	06/10/2003
,	*							Sampling Method:	5' CME Cor	ntinuous	Sheet:
	· ·		_					Hole Diameter:	8.5 inch		1 of 1
		ion	ery	Analy	/ses/Tests			Well Construction	: 2" sch 40 P'	VC, 0.001" slot	screen
_	ĵo.	ocat	ecov				loqu	Screen Interval:	20 ft.	to 5 f	<b>i.</b>
Depth (ft)	Graphic Log	Sampler Location	Sample Recovery		Lab Sample ID		USCS Symbol	Sand Pack:	20.5 ft.	to 3 ff	l.
Dep	Grap	Sam	Sam	PID (mdd)	Lab ⊡	Time	nsc	Seal:	3 ft.	to 1 ft	·
		\				0840		Description:	8" concrete pay		
		$  \setminus  $									
		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		1			-				
		Å					cl		y clay, moderate pl t, slightly moist, no		
		$  / \rangle$				<u> </u>	~		root scars	odor, lots of froi	n staining
		I/ \									
			36"	5							
<sub>-</sub> -		N /									
5		\ /							above, becoming m		
_		$  \setminus /  $		4					lowish brown, mode		sticity,
		l V		4				301	ne iron staining, no	Odor	
		***************************************									· · · · · ·
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III 1	N / ( A )	OTT.			W-U -	<u></u>		Client:	Boeing	Location:	Tract 1 North	Boring # MW3B
	VIA.	CTE			Well Lo	g		Logged E	Ву:	D. Brinkley		Project # 510098
Field	Locati	on:		A1				Drilled B	y:	Roberts En	vironmental	Date:
								Drilling N	Method:	Hollow Ster	n Auger	06/10/2003
] _	Ma							Sampling	g Method:	5' CME Cor	ntinuous	Sheet:
	A/A							Hole Dia	meter:	8.5 inch		1 of 1
		L.	چ	Analy	ses/Tests			Well Cor	nstruction:	2" sch 40 P	VC, 0.001" slot	screen
	Ď	ocatic	cove	Analy			loqu	Screen I	Interval:	20 ft.	to 5 f	it.
(#)	Graphic Log	Sampler Location	Sample Recovery		Lab Sample ID		USCS Symbol	Sand Pa	ack:	20 ft.	to 3 f	t.
Depth (ft)	Srapt	Samp	samp	PID (ppm)	ab S. D	Time	SSC	Seal:		3 ft.	to 1 f	t.
			0)	ш 🔾				Descript	tion:	1" asphalt, 6"		
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		$  \setminus  $					1			n burrows mostly		
						<u> </u>			core	, most extend ve	ertically 3-4" up t	o 1/8"dia.
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# Appendix B

**Underground Injection Control Permit** 

#### STATE OF MISSOURI

# DEPARTMENT OF NATURAL RESOURCES

### MISSOURI CLEAN WATER COMMISSION



# MISSOURI STATE OPERATING PERMIT

#### UNDERGROUND INJECTION CONTROL

Permit No		

UI-0000020

Owner: Address:

Address:

Boeing Company

PO Box 516, St. Louis, MO 63166

Continuing Authority:

Same as above

Same as above

Facility Name:

Boeing Fabrication Facility (Former)

Facility Address:

142 J.S. McDonnell Blvd., Hazelwood, MO 63042

Legal Description:

NW ¼, NW ¼, Sec. 5, T46N, R6E, St. Louis

Receiving Stream:

First Classified Stream and ID:

Unnamed Tributary to Coldwater Creek (U)

Coldwater Creek (C) (01706)

USGS Basin & Sub-watershed No.:

(10300200-180002)

### FACILITY DESCRIPTION

Underground Injection - SIC #7389 Direct push borings to inject about 5,000 pounds of Hydrogen Release Compound, which is a lactic acid producing mixture, to a depth of about 30 feet to remediate chlorinated solvents that are present in the subsurface.

April 19, 2002 Effective Date

Stephen Manfor , Director Departmen of Natural Resources Executive Secretar . Clean Water Commis

April 18, 2007

**Expiration Date** 

Interim Director of Staff, Clean Water Commission

#### A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

PAGE NUMBER 2 of 6

PERMIT NUMBER UI-0000020

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The final effluent limitations shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited and monitored by the permittee as specified below:

OUTEAU AUGMEE AND EES USAT		FINAL EFF	LUENT LIM	ITATIONS	MONITORING REQU	JIREMENTS
OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT FREQUENCY	SAMPLE TYPE
Preproject Monitoring						
pH - Units	នប	**		**	once before project begins	grab
Trichloroethylene (TCE)	mg/L	*		*	once before project begins	grab
Postproject Monitoring				·		
pH - Units	su	**		**	once after projects complet	grab ed
Trichloroethylene (TCE)	mg/L	*		*	once after projects complet	grab ed
Lactic Acid	mg/L	*			once after projects complet	grab ed
Total Pounds Chemical Injected	lbs				once after projects complet	report ed

MONITORING REPORTS SHALL BE SUBMITTED as outlined above; THE FIRST REPORT IS DUE as outlined above. THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

#### **B. STANDARD CONDITIONS**

IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Part I STANDARD CONDITIONS DATED October 1, 1980, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.

#### A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

- \* Monitoring requirement only.
- \*\* pH is measured in pH units and is not to be averaged. The pH is limited to the range of 6.0-9.0 pH units.

#### C. SPECIAL CONDITIONS

1. This permit does not allow for the surface discharge of any water. If permittee desires to discharge water to the surface, an NPDES State Operating Permit must first be obtained.

# STANDARD CONDITIONS FOR UNDERGROUND INJECTION CONTROL PERMIT

#### GENERAL CONDITIONS

## SECTION A - MONITORING AND REPORTING

- Representative Sampling
  - a. Samples and measurements taken as required herein shall be representative of the nature and volume.
  - b. Monitoring results shall be recorded and reported, postmarked no later than the 28<sup>th</sup> day of the month following the completed reporting period. Signed copies of these, and all other reports required herein, shall be submitted to the appropriate regional office and the Division of Geology and Land Survey, P.O. Box 250, Rolla, Missouri 65401.
- 2. Definitions

Definitions as set forth in the Missouri Clean Water Law and Missouri Clean Water Commission Definition Regulation 10 CSR 20-2.010 shall apply to terms used herein.

3. Test Procedures

Test procedures for the analysis of pollutants shall be in accordance with the Missouri Clean Water Commission Effluent Regulation 10 CSR 20-7.015.

- 4. Recording of Results
  - a. For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:
    - i. The date, exact place, and time of sampling or measurements;
    - ii. The individual(s) who performed the sampling or measurements;
    - iii.The date(s) analyses were performed;
    - iv. The individual(s) who performed the analyses;
    - v. The analytical techniques or methods used; and
    - vi. The results of such analyses.
  - b. The Federal Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than 6 months per violation, or both.
  - c. Calculations of all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.
- 5. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Monitoring Report Form. Such increased frequency shall also be indicated.

6. Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time.

Page 4 of 6

#### SECTION B - MANAGEMENT REQUIREMENTS

#### 1. Noncompliance Notification

- a. If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum limitation specified in this permit, the permittee shall provide the Department with the following information, in writing within five (5) days of becoming aware of such condition:
  - i. A description of the violation and cause of noncompliance, and
  - ii. The period of noncompliance, including exact dates and times or, if not corrected, that anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncompliance.
- b. Twenty-four hour reporting. The permittee shall report any noncompliance, which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The Department may waive the written report on a caseby-case basis if the oral report has been received within 24 hours.

#### Facilities Operation

Permittees shall operate and maintain facilities to comply with the Missouri Clean Water Law and applicable permit conditions.

#### Adverse Impact

The permittee shall take all necessary steps to minimize any adverse impact to waters of the state resulting from noncompliance with any limitations specified in this permit or set forth in the Missouri Clean Water Law and Regulations (hereinafter the Law and Regulations), including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

#### 4. Removed Substances

Solids, sludge, filter backwash, or other pollutants removed in the course of treatment or control of waters shall be disposed of in a manner such as to prevent any pollutants from entering waters of the state unless permitted by the Law, and a permanent record of the date and time, volume and methods of removal and disposal of such substances shall be maintained by the permittee.

#### 5. Right of Entry

For the purpose of inspecting, monitoring, or sampling the injection wells, point source, water contaminant source, or wastewater treatment facility for compliance with the Clean Water Law and these regulations, authorized representatives of the Department shall be allowed by the permittee, upon presentation of credentials and at reasonable times:

- a. to enter upon permittee's premises in which an injection well, point source, water contaminant source, or wastewater treatment facility is located or in which any records are required to be kept under terms and conditions of the permit;
- to have access to, or copy any records required to be kept under terms and conditions of the permit;
- c. to inspect any monitoring equipment or method required in the permit;
- d. to inspect any collection, treatment, or discharge facility covered under the permit; and
- e. to sample any wastewater at any point in the collection system or treatment process.

#### SECTION B - MANAGEMENT REQUIREMENTS (continued)

#### 6. Permits Transferable

a. Subject to section (3) of 10 CSR 20-6.010 an operating permit may be transferred upon submission to the Department of an application to transfer signed by a new owner. Until such time as the permit is officially transferred, the original permittee remains responsible for complying with the terms and conditions of the existing permit.

b. The Department, within thirty (30) days of receipt of the application shall notify the new permittee of its intent to revoke and reissue or transfer the permit.

### 7. Availability of Reports

Except for data determined to be confidential under the Missouri Clean Water Commission Regulation for Public Participation, Hearings and Notice to Governmental Agencies 10 CSR 20-6.020, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. As required by statute, operating data shall be subject to the imposition of criminal penalties as provided for in Section 644.076 of the Law.

#### 8. Permit Modifications

- a. Subject to compliance with statutory requirements of the Law and Regulations and applicable Court Order, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:
  - i. violation of any terms or conditions of this permit or the Law;
  - ii. having obtained this permit by misrepresentation or failure to disclose fully all relevant facts;
  - iii. a change in any circumstances or conditions that requires either a temporary or permanent reduction or elimination of the authorized discharge, or
  - iv. any reason set forth in the Law and Regulations.

### 9. Civil and Criminal Liability

Except as authorized by statute nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

#### 10. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state statute or regulations.

#### 11. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of or violation of federal, state or local laws or regulations.

#### 12. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for a new permit 180 days prior to expiration of this permit.

### SECTION B - MANAGEMENT REQUIREMENTS (continued)

#### 13. Signatory Requirement

All reports or information submitted to the Director shall be signed.

### 14. Rights Not Affected

Nothing in this permit shall affect the permittee's right to appeal or seek a variance from applicable laws or regulations as allowed by law.

#### 15. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

# Appendix C

Analytical Laboratory Reports and Chain-of-Custody Forms





## ANALYTICAL REPORT

November 19, 2001

Page 1 of 1

Work Order: 11J1098

Report To

Doug Marian Harding ESE

3199 River Port Tech Center

St. Louis, MO 63043

Project:

Boeing/GKN

Project Number: Boeing

**Work Order Information** 

Date Received: 10/26/2001 11:05AM

Collector:

Collector Phone: 314-567-4600

PO Number:

Analyte		Result	MRL	Method	Analyst	Analyzed	Qualifier
11J1098-01	MW3W			Matrix: Water	. (	Collected:	10/25/01 15:55
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	FIZ	11/16/01	9:47

End of Report

Keystone Laboratories, Inc. Ericka Weintz

Pricka Weint

Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Environmental Science & Engineering, Inc.

## FOR LAB USE ONLY

1151098 0078

11665 Lilburn Park Road, St. Louis, MO 63146-3535 Telephone: (314) 567-4600 -- Fax: (314) 567-5030

Project Number:

**Chain of Custody Record** 

Client: HAL  Address: 3/9  57  Phone #: (3/4) 20  P.O. #:  Client Contact:  Project # / Location	9 RI COU DOUG	vert	MO (ax#: (	63 314) 5	043		1. Wa 2. Soil 3. Sluc 4. Oil 5. Tissu Other Preser 1. Non	ter dge ue : vative: e  4. NaC O4  5. HCI		С					Ar	naly			/emperature/inity		
Sample I.D. (10 Characters ONLY)	Sample Type	Size	ontainer Type	No.	Samp Date	ling Time	Preser- vative	Lab I.D.			//		//			//	Ha	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	oue,	Com	ments
MW3W		40 M	(5	2	10/25/61	1555	NONE		×							0/			N	ON P	RESERVE
Relinquished By: Relinquished By:		Date:/6 Time: / Date: Time:	7:2		Receive	ed For La	•	Date Time Date Time	:10-26	05		San	R LAI	eceiv es	ed C	hille No					°C

SPECIAL INSTRUCTIONS:

PRESERVE HAT.



RECEIVED SEP 27 2002





Accreditations: Iowa DNR: 095 New Jersey DEP: IA001 Kansas DHE: E-10287

# ANALYTICAL REPORT

**September 25, 2002** 

Page 1 of 2

Work Order: 12F0702

Report To

Dennis Brinkley Harding ESE - MO

3199 River Port Tech Center

St. Louis, MO 63043

Project: Boeing/GKN

Project Number: Boeing

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Date Received: 06/20/2002 10:00AM

Collector: Friesner, Jack Phone: 314-567-4600

PO Number:

Analyte		Result	MRL	Method		Analyzed Qualifi	_
2F0702-01	MW3W			Matrix:Water		Collected: 06/19/02 08:30	)
					<b>11 T</b> T	06/26/02 23:24	
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	ЛLН	06/26/02 23:24	
Lactic Acid (C3)		26.6 mg/l	1.0	HPLC/UV	JLH GGD	06/26/02 23:24	
Lactic Acid (C3)		26.6 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
Propionic Acid (C3)	grand grand grand and service and the service of th	<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:24	
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV			
12F0702-02	MW3AW			Matrix:Water		Collected: 06/19/02 17:4	-5
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH	06/26/02 23:45	
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	GGD	06/26/02 23:45	
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/26/02 23:45	
12F0702-03	MW3BW		<u>, </u>	Matrix:Water		Collected: 06/19/02 15:0	)()
					** **	0.6/0.7/02 0.06	
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH	06/27/02 0:06	
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	GGD	06/27/02 0:06	
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	
Acetic Acid (C2)		<1.0  mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH	06/27/02 0:06	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.







Harding ESE - MO 3199 River Port Tech Center St. Louis, MO 63043

Work Order: 12F0702

**September 25, 2002** 

Page 2 of 2

End of Report

Keystone Laboratories, Inc. Ericka Weintz

Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

# CHAIN OF CUSICUY KECORD

<b>Veystone</b>
LABORATORIES, INC.

600 E. 17<sup>th</sup> St. S. Newton, IA 50208

Phone: 641-792-8451 Fax: 641-792-7989

3012 Ansborough Ave. Waterloo, IA 50701

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Kansas City, KS 66103 Phone: 913-321-7856 Fax: 913-321-7937

PAGE\_\_\_\_OF\_\_\_

ADDRESS:	REPORT TO:  NAME: DENNIS BRINCLEY  COMPANY NAME: HARDING ESE  ADDRESS: 3199 RIVERPORT TECH CENTER Dr.  CITY/ST/ZIP: MARYLAND HENCHTSMO 6318  PHONE: (314) 209-5900	BILL TO:  NAME:  COMPANY NAME: HARDING ESE  ADDRESS:  CITY/ST/ZIP:  PHONE:
PHONE:	FAX: (314) 209 - 59 27	Keystone Quote No.:(If Applicable)

1110112															(If Appli	cable)
					S			n	ANA	LYSE	SREC	UIRE	D		LAB USE	
					INER		SITE	Acibs							LABORATORY WORK ORDER N	
CLIENT SAMPLE NUMBER	DATE	TIME	SAMPI	LE LOCATION	NO. OF CONTAINERS	MATRIX	GRAB/COMPOSITE	METABOUC							SAMPLE TEMPERATURE UPON RECEIPT:  °C  SAMPLE CONDITION/COMMENTS	LABORATORY SAMPLE NUMBER
MW3W	6/19/02	0836			1	GW		X				4				01
	6/18/02	1745			1	GW		X								Q
	6/18/02	1500			J	GW		X						]		03
														_		
	<u> </u>	l				L			11			11				
Relinquished by: Signature	∋)	Date 6	17102	ved by: (Signature)		Dat					Around: Standa			[	Rush	
/W 69~		Time 7	30			1 11111									Contact Lab P	rior to Submission

	<u> </u>					
Relinquished by: Signature)	Date 6/19/02	Received by: (Signature)	Date	Turn-Around:	D ph	
	Time 17-30		Time	Standard	☐ Rush _	Contact Lab Prior to Submission
Relinguished by: (Signature)	Date	Received for Lab by: (Signature)	Date 20 03	Remarks:		
	Time	7 KID	Time 0:00			
		Original - Return with Report • Ye	ellow - Lab Copy •	Pink - Sampler Copy		FORM: CCR 7







Accreditations: lowa DNR: 095 New Jersey DEP: IA001 Kansas DHE: E-10287

## ANALYTICAL REPORT

October 10, 2002

Page 1 of 3

Work Order: 12I0812

Report To

Dennis Brinkley Harding ESE - MO 3199 River Port Tech Center St. Louis, MO 63043

Project : Boeing/GKN Project Number: Boeing **Work Order Information** 

Date Received: 09/24/2002 10:40AM

Collector:

Phone: 314-567-4600

PO Number:

Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
			Matrix:Water		Collected: 09/23/0	
<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 20:19	
<1.0 mg/l	1.0	1J20820	HPLC/UV	ЛLН	10/07/02 20:19	
<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:19	
<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH		
<1.0 mg/l	1.0	1J20820	HPLC/UV	ЛLН	10/07/02 20:19	
			Matrix:Water		Collected: 09/23/0	2 08:20
<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 20:47	
<1.0  mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
< 1.0  mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 20:47	
			Matrix:Water	(	Collected: 09/19/0	2 14:40
<0.1 mg/l	0.1	1J20820	HPLC/UV	JLH	10/07/02 21:15	
<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH		
<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
<1.0 mg/l	1.0	1J20820	HPLC/UV	JLH	10/07/02 21:15	
	<0.1 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l	<0.1 mg/l <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0 <1.0 mg/l 1.0	<pre>&lt;0.1 mg/l</pre>	Matrix:Water	Matrix:Water	Matrix:Water   Collected: 09/23/0

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.







Harding ESE - MO 3199 River Port Tech Center St. Louis, MO 63043

Work Order: 12I0812

October 10, 2002 Page 2 of 3

RPD

## **Determination of Metabolic Acids - Quality Control Keystone Laboratories, Inc. - Newton**

Spike

Source

%REC

Reporting

Pruvic Acid (C3) ND 0.1 mg/l Acetic Acid (C3) ND 1.0 " Propionic Acid (C4) ND 1.0 "  Propionic Acid (C4) ND 1.0 "  Prepared & Analyzed: 10/07/02  Pruvic Acid (C3) South Acetic Acid (C4) South Acetic Acid (C5) South Acetic Acid (C4) South Acetic Acid (C4) South Acetic Acid (C5) South Acetic Acid (C	Analyte	Result	Limit	Units	Level	Result	%REC	Limits	RPD	Limit	Notes
Pruvic Acid (C3) ND 0.1 mg/1 Acetic Acid (C3) ND 1.0 " Propionic Acid (C4) ND 1.0 "  Propionic Acid (C4) ND 1.0 "  Prepared & Analyzed: 10/07/02  Pruvic Acid (C3) South Acetic Acid (C4) South Acetic Acid (C4) South Acetic Acid (C4) South Acetic Acid (C4) South Acetic Acid (C4) South Acetic Acid (C5) South Acetic Acid (C	Batch 1J20820 - General Prep HPLC	СЛС									
Acetic Acid (C3)  Acetic Acid (C3)  Acetic Acid (C3)  Acetic Acid (C3)  Acetic Acid (C4)  ND  1.0  "  Prepared & Analyzed: 10/07/02  Propionic Acid (C3)  Source: 1210814-01  Prepared & Analyzed: 10/07/02  Propionic Acid (C3)  Acetic Acid (C4)  Acetic Acid (C4)  Acetic Acid (C5)  Acetic Acid (C4)  Acetic Acid (C5)  Acetic Acid (C4)  Acetic Acid (C5)  Ac	Blank (1J20820-BLK1)	Prepared	& Analyze	ed: 10/07/	02						
Acetic Acid (C2)  ND  1.0  Propionic Acid (C3)  ND  1.0  "  Prepared & Analyzed: 10/07/02  Province Acid (C3)  ND  1.0  "  Prepared & Analyzed: 10/07/02  Province Acid (C3)  S5.00  0.1  mg/l  56.70  97.0  66-134  Acetic Acid (C3)  237.3  1.0  "  198.9  119  68-138  Acetic Acid (C2)  Propionic Acid (C3)  149.7  1.0  "  150.8  99.3  73-122  Propionic Acid (C3)  3utyric Acid (C4)  146.7  1.0  "  156.0  100  77-120  3utyric Acid (C4)  Prepared & Analyzed: 10/07/02  Province Acid (C4)  Propionic Acid (C4)  146.7  1.0  "  146.4  100  75-119  Matrix Spike (1J20820-MS1)  Source: 1210814-01  Prepared & Analyzed: 10/07/02  Province Acid (C3)  46.34  0.1  mg/l  37.80  ND  123  58-127  Acetic Acid (C3)  46.34  0.1  mg/l  37.80  ND  123  58-127  Acetic Acid (C3)  Acetic Acid (C3)  182.5  1.0  "  100.6  ND  117  65-128  Propionic Acid (C4)  ND  120  804-128  Analyzed: 10/07/02  Province Acid (C3)  Acetic Acid (C3)  183.3  1.0  "  100.6  ND  111  67-127  Prepared & Analyzed: 10/07/02  Province Acid (C3)  Acetic Acid (C3)  183.3  1.0  "  100.6  ND  111  67-127  Acetic Acid (C3)  45.87  0.1  mg/l  37.80  ND  121  58-127  1.02  28  Acetic Acid (C3)  Acetic Acid (C	Pyruvic Acid (C3)	ND	0.1	mg/l		-					
Propionic Acid (C3) Butyric Acid (C4) ND 1.0 " Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3) S5.00 0.1 mg/l 56.70 97.0 66-134	Lactic Acid (C3)	ND	1.0	**							
Prepared & Analyzed: 10/07/02  Propared & Analyzed: 10/07/02	Acetic Acid (C2)	ND	1.0	n							
Prepared & Analyzed: 10/07/02	Propionic Acid (C3)	ND	1.0	**							
Pryruric Acid (C3) 55.00 0.1 mg/l 56.70 97.0 66-134 Lactic Acid (C3) 237.3 1.0 " 198.9 119 68-138 Acetic Acid (C2) 149.7 1.0 " 150.8 99.3 73-122 Propionic Acid (C3) 156.7 1.0 " 156.0 100 77-120 Butyric Acid (C4) 146.7 1.0 " 146.4 100 75-119  Matrix Spike (1J20820-MS1) Source: 12I0814-01 Prepared & Analyzed: 10/07/02  Pryruric Acid (C3) 46.34 0.1 mg/l 37.80 ND 123 58-127 Lactic Acid (C2) 117.3 1.0 " 100.6 ND 117 65-128 Propionic Acid (C3) 133.3 1.0 " 104.0 ND 128 64-128 Butyric Acid (C4) 108.6 1.0 " 97.60 ND 111 67-127  Matrix Spike Dup (1J20820-MSD1) Source: 12I0814-01 Prepared & Analyzed: 10/07/02  Pryruric Acid (C3) 45.87 0.1 mg/l 37.80 ND 121 58-127 1.02 28 Lactic Acid (C3) 45.87 0.1 mg/l 37.80 ND 121 58-132 1.85 29 QM-05 Acetic Acid (C3) 185.9 1.0 " 132.6 ND 140 58-132 1.85 29 QM-05 Acetic Acid (C3) 185.9 1.0 " 132.6 ND 140 58-132 1.85 29 QM-05 Acetic Acid (C3) 185.9 1.0 " 132.6 ND 140 58-132 1.85 29 QM-05 Acetic Acid (C3) 134.6 1.0 " 100.6 ND 120 65-128 2.69 31 Acetic Acid (C3) 134.6 1.0 " 104.0 ND 129 64-128 0.971 28 QM-05 Acetic Acid (C3) 134.6 1.0 " 104.0 ND 129 64-128 0.971 28 QM-05 Acetic Acid (C3) 134.6 1.0 " 104.0 ND 129 64-128 0.971 28 QM-05	Butyric Acid (C4)	ND	1.0	Ħ							
Acetic Acid (C3)  Acetic Acid (C2)  149.7  1.0  150.8  99.3  73-122  Propionic Acid (C3)  156.7  1.0  156.0  100  77-120  Butyric Acid (C4)  146.7  1.0  146.4  100  75-119  Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3)  182.5  1.0  182.5  1.0  100.6  ND  117  65-128  Propionic Acid (C3)  133.3  1.0  104.0  ND  128  64-128  Prepared & Analyzed: 10/07/02  Matrix Spike Dup (1J20820-MSD1)  Source: 12I0814-01  Source: 12I0814-01  Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3)  183.3  1.0  104.0  ND  117  107  108  107  109  100  ND  111  107  100  100  100  100  100  10	LCS (1J20820-BS1)				Prepared	& Analyzo	ed: 10/07/	02			
Acetic Acid (C2)  149.7  1.0  150.8  99.3  73-122  Propionic Acid (C3)  156.7  1.0  156.0  100  77-120  Butyric Acid (C4)  146.7  1.0  " 146.4  100  75-119  Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3)  Acetic Acid (C3)  182.5  1.0  " 132.6  ND 138  58-132  QM-05  Propionic Acid (C3)  133.3  1.0  " 104.0  ND 111  67-127  Matrix Spike Dup (1J20820-MSD1)  Source: 12I0814-01  Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3)  182.5  100  " 100.6  ND 117  65-128  Propionic Acid (C3)  183.3  1.0  " 104.0  ND 128  64-128  Butyric Acid (C4)  Matrix Spike Dup (1J20820-MSD1)  Source: 12I0814-01  Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3)  45.87  0.1  mg/l 37.80  ND 121  58-127  1.02  28  Acetic Acid (C3)  45.87  0.1  mg/l 37.80  ND 121  58-127  1.02  28  Acetic Acid (C3)  45.87  0.1  mg/l 37.80  ND 121  58-127  1.02  28  Acetic Acid (C3)  Acetic Acid (C3)  185.9  1.0  " 100.6  ND 120  65-128  2.69  31  Propionic Acid (C3)  134.6  1.0  " 104.0  ND 129  64-128  0.971  28  QM-05  QM-05  QM-05  QM-05  Acetic Acid (C3)  134.6  1.0  " 100.6  ND 120  65-128  0.971  28  QM-05  Q	Pyruvic Acid (C3)	55.00	0.1	mg/l	56.70		97.0	66-134			
Propionic Acid (C3) Butyric Acid (C4) Butyric Acid (C4) Butyric Acid (C4) Butyric Acid (C4) Butyric Acid (C4) Butyric Acid (C4) Butyric Acid (C4) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C3) Butyric Acid (C4) Butyric Acid (C4) Butyric Acid (C4) Butyric Acid (C4) Butyric Acid (C5) Butyric Acid (C3) Butyric Ac	Lactic Acid (C3)	237.3	1.0	**	198.9		119	68-138			
Matrix Spike (1J20820-MS1)  Source: 1210814-01  Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3)  Acetic Acid (C3)  Acetic Acid (C3)  Butyric Acid (C3)  Acetic Acid (C3)  Acetic Acid (C3)  Butyric Acid (C4)  Butyric Acid (C5)  Butyric Acid (C4)  Butyric Acid (C5)  Butyric Acid (C6)  Butyric Acid (	Acetic Acid (C2)	149.7	1.0	#	150.8		99.3	73-122			
Matrix Spike (1J20820-MS1)  Source: 12I0814-01  Prepared & Analyzed: 10/07/02  Proprior Acid (C3)  46.34  0.1 mg/l  37.80 ND  123 58-127  Lactic Acid (C3)  182.5  1.0 "  132.6 ND  138 58-132  QM-05  Acetic Acid (C2)  117.3  1.0 "  100.6 ND  117 65-128  Proprioric Acid (C3)  133.3  1.0 "  104.0 ND  128 64-128  Butyric Acid (C4)  108.6  1.0 "  97.60 ND  111 67-127  Matrix Spike Dup (1J20820-MSD1)  Source: 12I0814-01  Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3)  45.87  0.1 mg/l  37.80 ND  121 58-127  1.02 28  Lactic Acid (C3)  45.87  0.1 mg/l  37.80 ND  121 58-127  1.02 28  Lactic Acid (C3)  Acetic Acid (C3)  185.9  1.0 "  132.6 ND  140 58-132  1.85 29  QM-05  Proprioric Acid (C3)  120.5  1.0 "  100.6 ND  120 65-128  2.69  31  Proprioric Acid (C3)  134.6  1.0 "  104.0 ND  129 64-128  0.971  28 QM-05	Propionic Acid (C3)	156.7	1.0	"	156.0		100	77-120			
Pyruvic Acid (C3) 46.34 0.1 mg/l 37.80 ND 123 58-127 Lactic Acid (C3) 182.5 1.0 " 132.6 ND 138 58-132 QM-05 Acetic Acid (C2) 117.3 1.0 " 100.6 ND 117 65-128 Propionic Acid (C3) 133.3 1.0 " 104.0 ND 128 64-128 Butyric Acid (C4) 108.6 1.0 " 97.60 ND 111 67-127  Matrix Spike Dup (1J20820-MSD1) Source: 12I0814-01 Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3) 45.87 0.1 mg/l 37.80 ND 121 58-127 1.02 28 Lactic Acid (C3) 185.9 1.0 " 132.6 ND 149 58-132 1.85 29 QM-03 Acetic Acid (C2) 120.5 1.0 " 100.6 ND 120 65-128 2.69 31  Propionic Acid (C3) 134.6 1.0 " 104.0 ND 129 64-128 0.971 28 QM-05	Butyric Acid (C4)	146.7	1.0	#	146.4		100	75-119			
Acetic Acid (C3)  182.5  1.0  182.6  ND  138  58-132  QM-05  Acetic Acid (C2)  117.3  1.0  100.6  ND  117  65-128  Propionic Acid (C3)  133.3  1.0  104.0  ND  128  64-128  Butyric Acid (C4)  108.6  1.0  108.6  1.0  108.6  1.0  108.6  1.0  108.6  1.0  108.6  1.0  108.6  1.0  108.6  1.0  108.6  1.0  108.6  1.0  108.6	Matrix Spike (1J20820-MS1)	S	ource: 12I081	4-01	Prepared	& Analyze	ed: 10/07/	02			
Acetic Acid (C2) 117.3 1.0 " 100.6 ND 117 65-128 Propionic Acid (C3) 133.3 1.0 " 104.0 ND 128 64-128 Butyric Acid (C4) 108.6 1.0 " 97.60 ND 111 67-127  Matrix Spike Dup (1J20820-MSD1) Source: 12I0814-01 Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3) 45.87 0.1 mg/l 37.80 ND 121 58-127 1.02 28	Pyruvic Acid (C3)	46.34	0.1	mg/l	37.80	ND	123	58-127			
Propionic Acid (C3) 133.3 1.0 " 104.0 ND 128 64-128 Butyric Acid (C4) 108.6 1.0 " 97.60 ND 111 67-127  Matrix Spike Dup (1J20820-MSD1) Source: 12I0814-01 Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3) 45.87 0.1 mg/l 37.80 ND 121 58-127 1.02 28  Lactic Acid (C3) 185.9 1.0 " 132.6 ND 140 58-132 1.85 29 QM-03  Acetic Acid (C2) 120.5 1.0 " 100.6 ND 120 65-128 2.69 31  Propionic Acid (C3) 134.6 1.0 " 104.0 ND 129 64-128 0.971 28 QM-05	Lactic Acid (C3)	182.5	1.0	**	132.6	ND	138	58-132			QM-05
Butyric Acid (C4) 108.6 1.0 " 97.60 ND 111 67-127  Matrix Spike Dup (1J20820-MSD1) Source: 12I0814-01 Prepared & Analyzed: 10/07/02  Pyruvic Acid (C3) 45.87 0.1 mg/l 37.80 ND 121 58-127 1.02 28  Lactic Acid (C3) 185.9 1.0 " 132.6 ND 149 58-132 1.85 29 QM-03  Acetic Acid (C2) 120.5 1.0 " 100.6 ND 120 65-128 2.69 31  Propionic Acid (C3) 134.6 1.0 " 104.0 ND 129 64-128 0.971 28 QM-05	Acetic Acid (C2)	117.3	1.0	**	100.6	ND	117	65-128			
Matrix Spike Dup (1J20820-MSD1)         Source: 12I0814-01         Prepared & Analyzed: 10/07/02           Pyruvic Acid (C3)         45.87         0.1 mg/l         37.80 ND         121 58-127 1.02 28           Lactic Acid (C3)         185.9         1.0 "         132.6 ND         140 58-132 1.85 29 QM-03           Acetic Acid (C2)         120.5         1.0 "         100.6 ND         120 65-128 2.69 31           Propionic Acid (C3)         134.6         1.0 "         104.0 ND         129 64-128 0.971 28 QM-05	Propionic Acid (C3)	133.3	1.0	н	104.0	ND	128	64-128			
Pyruvic Acid (C3)       45.87       0.1 mg/l       37.80 ND       121 58-127 1.02 28         Lactic Acid (C3)       185.9       1.0 " 132.6 ND 149 58-132 1.85 29 QM-03         Acetic Acid (C2)       120.5 1.0 " 100.6 ND 120 65-128 2.69 31         Propionic Acid (C3)       134.6 1.0 " 104.0 ND 129 64-128 0.971 28 QM-05	Butyric Acid (C4)	108.6	1.0	н	97.60	ND	111	67-127			
Acetic Acid (C3) 185.9 1.0 " 132.6 ND 140 58-132 1.85 29 QM-03 Acetic Acid (C2) 120.5 1.0 " 100.6 ND 120 65-128 2.69 31 Propionic Acid (C3) 134.6 1.0 " 104.0 ND 129 64-128 0.971 28 QM-05	Matrix Spike Dup (1J20820-MSD1)	Se	ource: 12I081	4-01	Prepared	& Analyze	ed: 10/07/	02			
Acetic Acid (C2) 120.5 1.0 " 100.6 ND 120 65-128 2.69 31  Propionic Acid (C3) 134.6 1.0 " 104.0 ND 129 64-128 0.971 28 QM-05	Pyruvic Acid (C3)	45.87	0.1	mg/l	37.80	ND	121	58-127	1.02	28	
Propionic Acid (C3) 134.6 1.0 " 104.0 ND 129 64-128 0.971 28 QM-05	Lactic Acid (C3)	185.9	1.0	<b>"</b> .	132.6	ND	140	58-132	1.85	29	QM-03
	Acetic Acid (C2)	120.5	1.0	н .	100.6	ND	120	65-128	2.69	31	
Butyric Acid (C4) 113.2 1.0 " 97.60 ND 116 67-127 4.15 26	Propionic Acid (C3)	134.6	1.0	"	104.0	ND	129	64-128	0.971	28	QM-05
	Butyric Acid (C4)	113.2	1.0	n	97.60	ND	116	67-127	4.15	26	

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference

#### **Notes and Definitions**

QM-05 The spike recovery was outside acceptance limits for the MS and/or MSD due to matrix interference. The LCS and/or LCSD were within acceptance limits showing that the laboratory is in control and the data is acceptable.

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.







Harding ESE - MO 3199 River Port Tech Center St. Louis, MO 63043

Work Order: 12I0812

October 10, 2002

Page 3 of 3

End of Report

Keystone Laboratories, Inc.

Ericka Weintz Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.



11665 Lilbum Park Road, St. Lonis, MO 63146-3535 Telephone: (314) 567-4600 Fax: (314) 567-5030

# FOR LAB USE ONLY

# **Chain of Custody Record**

Client: HARDING	ESÉ	Sample Ty 1. Water	P - Plastic	Analyses
Phone #: (31) 29 - 59 P.O. #: Client Contact: DENN Project # / Location: B	MO 63043  FOX #: BIY) 209  US BRINKLEY >	3. Sludge 4. Oil 5. Tissue Other: Preservati 1. None	ve: 4. NaOH	The local distribution of the local distribu
Sample I.D. Sample (10 Characters ONLY) Type	Container Size Type No. [	Sampling Preser- Date Time vative L	ab I.D.	TA SA Comments
MW3A 1		123/02 0715 6	X	0/
MW3\$		123 kg 0820 6	X	02
MW3B /	80ml 7ms 1 91	19/ac 1440 6		
			10	
Relinquished By:	Date: 923 02 F	Received By:	Date:	FOR LARLICE ONLY
Jas Li	Time: 100		Time: :	FOR LAB USE ONLY Samples Received Chilled
Relinquished By:	Date:9-23 02	Received For Lab By:	Date: 92402	Yes No
1-5-17	Time:/125:	NW		City L. Commun. Lab Departure: Dirty Lab Elle, Coldered Detained by Sampler

SPECIAL INSTRUCTIONS:







Accreditations: lowa DNR: 095 New Jersey DEP: IA001 Kansas DHE: E-10287

## ANALYTICAL REPORT

January 08, 2003

Page 1 of 1

Work Order: 12L0584

Work Order Information

Date Received: 12/17/2002 10:04AM

Collector: Friesner, Jack Phone: 314-567-4600

PO Number:

Report To

Dennis Brinkley

MACTEC (Harding ESE) 3199 River Port Tech Center

St. Louis, MO 63043

Project: Boeing/GKN Project Number: Boeing/GKN

Analyte		Result	MRL	Method	Analys	t Analyzed Qualifier
Pyruvic Acid (C3) Lactic Acid (C3) Acetic Acid (C2)	MW3BW	<0.2 mg/l <2.0 mg/l <2.0 mg/l	0.2 2.0 2.0	Matrix:Water HPLC/UV HPLC/UV HPLC/UV	JLH JLH JLH JLH	Collected: 12/16/02 13:55 01/07/03 10:20 R-01 01/07/03 10:20 R-01 01/07/03 10:20 R-01
Propionic Acid (C3) Butyric Acid (C4)		<2.0 mg/l <2.0 mg/l	2.0	HPLC/UV HPLC/UV	JLH JLH	01/07/03 10:20 R-01 01/07/03 10:20 R-01 01/07/03 10:20 R-01
Pyruvic Acid (C3) Lactic Acid (C3) Acetic Acid (C2) Propionic Acid (C3) Butyric Acid (C4)	MW3W	<0.1 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l	0.1 1.0 1.0 1.0 1.0	Matrix:Water HPLC/UV HPLC/UV HPLC/UV HPLC/UV HPLC/UV	JLH JLH JLH JLH JLH	Collected: 12/16/02 15:05 01/06/03 15:12 01/06/03 15:12 01/06/03 15:12 01/06/03 15:12 01/06/03 15:12
Pyruvic Acid (C3) Lactic Acid (C3) Acetic Acid (C2) Propionic Acid (C3) Butyric Acid (C4)	MW3AW	<0.1 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l <1.0 mg/l	0.1 1.0 1.0 1.0 1.0	Matrix:Water HPLC/UV HPLC/UV HPLC/UV HPLC/UV HPLC/UV	JLH JLH JLH JLH JLH	Collected: 12/16/02 16:35 01/06/03 15:34 01/06/03 15:34 01/06/03 15:34 01/06/03 15:34 01/06/03 15:34

#### Notes and Definitions

R-01

The Reporting Limit for this analyte has been raised to account for matrix interference.

End of Report

Keystone Laboratories, Inc.

Oricka Wein

Ericka Weintz Project Manager

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# CHAIN OF CUSIONY RECURD

1	12)	/sto	ne
L	A B O R A	TORIES,	INC.

600 E. 17<sup>th</sup> St. S. Newton, IA 50208

Phone: 641-792-8451 Fax: 641-792-7989 3012 Ansborough Ave. Waterloo, IA 50701

Phone: 319-235-4440 Fax: 319-235-2480 ☐ 1304 Adams

Kansas City, KS 66103 Phone: 913-321-7856 Fax: 913-321-7937

PAGE\_ | OF\_

ADDRESS:	ADDRESS: 3199 RIVERPORT TEXT CENTER Dr. CITY/ST/ZIP: ST LOUIS MYO 63043	BILL TO:  NAME: DENNIS BRINCLEY  COMPANY NAME: MACTEC  ADDRESS: 3199 RIVERY FOLK COURSE DE  CITY/ST/ZIP: St Louis MO 63043  PHONE: (314) 201-5900
CITY/ST/ZIP:	1110111212	Keystone Quote No.:(If Applicable)
PHONE:		<u> </u>

PHONE:			FAX: (314) &	w9	<u>~ 593</u>	29_				Keyston	e Quote No	:(If Appli	cable)
CLIENT SAMPLE NUMBER	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	MATRIX	GRAB/COMPOSITE	METABOLIC ACIUK(6)	IALYS	SES RE	QUIRED	SAMPL UPON	LAB USE OF ATORY WORK ORDER NO SET TEMPERATURE RECEIPT:  C C C C C C C C C C C C C C C C C C	
MW3BW	12/16/02	1355		1	6w		X						02
MW3W MW3AW	12/16/02	1505 16 <b>3</b> 5		1	6W		X						03
÷ .													
elinquished by (Signatur	e)	Date 12 id Time	Received by: (Signature)		Dat	e		<del>2</del>		d: dard	Ū R	ush Contact Lab F	rior to Submission
elinquished by: (Signatur	re)	Date	Received for Lab by: (Signatu	ıre)	Dat Tim			Rei	marks:				FORM: CCR

Relinquished by (Signature)	Date 12 16 02	Received by: (Signature)	Date	Turn-Around:	Rush
Just.	Time 1 <b>9</b> .30		Time	Standard	Contact Lab Prior to Submission
Relinquished by: (Signature)	Date	Received for Lab by: (Signature)	Date	Remarks:	
	Time	-	Time		FORM COR 7.
		Original - Return with Report •	Yellow - Lab Copy •	Pink - Sampler Copy	FORM: CCR 7-9







Accreditations: Iowa DNR: 095 New Jersey DEP: IA001 Kansas DHE: E-10287

### ANALYTICAL REPORT

March 20, 2003

Work Order: 13C0609

Page 1 of 1

Report To

Dennis Brinkley MACTEC (Harding ESE) 3199 River Port Tech Center St. Louis, MO 63043

Project: Boeing/GKN Project Number: Boeing

		120	× 99	•	200	200	8	600	606		X	600		89.	98	200	300	323		:42.	þ
٧.	W	Ω			8 0	)r	21	Δ		38	-	8 2	•	20	-			200		-	
8.0	3.8	300	28	ж.	100	A 20	u	100	300	28	1.	86	83	88	13	8 2	78	31 1	88	83	
81.85×	100	ಯನ	3000	03.44		130 CA	100			200	200	100	.24	220	300		900	2.00	and or	2002	ā

Date Received: 03/18/2003 1:22PM

Collector:

Phone: 314-567-4600

PO Number:

Analyte		Result	MRL	Method	Anglyst	Analyzad	Ougliffer
13C0609-01	MW3BW	~100441	MINE	Matrix:Water		Callacted 02/15	Qualifier
Pyruvic Acid (C3)	· · · <del>-</del> · · ·	<0.1 ma/1	0.1			Collected: 03/17	
Lactic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 20:3	
` /		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:3	
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:3	31
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:3	31
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:3	_
12000000	Lauran						
13C0609-02	MW3B		_	Matrix:Water		Collected: 03/17	7/03 18:15
Pyruvic Acid (C3)		<0.1  mg/l	0.1	HPLC/UV	JLH	03/18/03 20:5	72
Lactic Acid (C3)		<1.0  mg/l	1.0	HPLC/UV	JLH	03/18/03 20:5	
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:5	
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 20:5	· <del>- ·</del>
Butyric Acid (C4)		<1.0 mg/l	1.0	HPLC/UV	ЛLН	03/18/03 20:5	-
						22. 20.00 20.0	· <del></del>
13C0609-03	MW3BAW			Matrix:Water		Collected: 03/17	7/03 16:30
Pyruvic Acid (C3)		<0.1 mg/l	0.1	HPLC/UV	JLH	03/18/03 21:1	
Lactic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:1	
Acetic Acid (C2)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:1	
Propionic Acid (C3)		<1.0 mg/l	1.0	HPLC/UV			
Butyric Acid (C4)					JLH	03/18/03 21:1	
241, 1014 (C4)		<1.0 mg/l	1.0	HPLC/UV	JLH	03/18/03 21:1	4

End of Report

Keystone Laboratories, Inc.

Ericka Weinh

Ericka Weintz Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted.  $MRL=Method\ Reporting\ Limit.$ 



Science & Engineering, Inc.

11<del>665 Lilburn Park Road, St. Louis, MO 63146-353</del>5 Telephone: (314) 567-4600 -- Fax. (314) 567-5030

# FOR LAB USE ONLY Project Number: 136609

# **Chain of Custody Record**

Client: MACT Address: 3199 St. L  Phone #: 319 2  P.O. #: Client Contact: Project # / Location	0015	00 F	ax#: (3	314) <u>20</u> 0	9-592	29	1. Wat 2. Soll 3. Sluc 4. Oil 5. Tissu Other Preser 1. Non	dge .: .: .: .: .: .: .: .: .: .: .: .: .:	P - F G - ( V - \	Plasti Slass /OC	ic s						Ana	/se	//	Offic Cond.	Comments
Sample I.D.	Sample	Co	ontainer Type	No.	Sampl Date	ing Time	Preser- vative	Lab 1	l.D. /	Z	" /	<b>/</b> //	/ /	//		/ /	/ /	/0			
MW3BW MW3W MW3AW	6W 6W	,			3/17/03	1405 1815 1630	_ ,	PHOS	- IN	X											03
Relinquished By:		Time:	3-17 20:0			ved By:	ab By:		Date: Time: Date: Time:	3	18	- 03 22		Samp E	oles Ri Ve	ecel is	E ON red Cl	nilled Io		Golde	°C enrod - Retained by Sampler

SPECIAL INSTRUCTIONS:







Accreditations: Iowa DNR: 095 New Jersey DEP: IA001 Kansas DHE: E-10287

## **ANALYTICAL REPORT**

June 26, 2003

Page 1 of 3

Work Order: 13F0789

Report To

Dennis Brinkley
MACTEC E & C - MO
3199 River Port Tech Center
St. Louis, MO 63043

Project : Boeing/GKN Project Number: Boeing

### Work Order Information

Date Received: 06/19/2003 9:43AM Collector: Jack E. Friesney Phone: 314-567-4600

PO Number:

Analyte	Result	MRL	Batch	Method	Analyst Analyzed Qualifie
13F0789-01 MW3RW			Butter	1.1001104	Analyst Analyzed Qualifie
1121131311				Matrix:Water	Collected: 06/18/03 12:30
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	JLH 06/24/03 14:45
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535	HPLC/UV	
Propionic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	
Butyric Acid (C4)	<1.0 mg/l	1.0	1F32535	HPLC/UV	00.2 105 14.45
			110200	THE BOTO V	JLH 06/24/03 14:45
13F0789-02 MW3AW				Matrix:Water	Collected: 06/18/03 15:10
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:07
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:07
Propionic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:07
Butyric Acid (C4)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:07
			11 32333	TIFLC/UV	JLH 06/24/03 15:07
<b>13F0789-03</b> MW3W				Matrix:Water	Collected: 06/18/03 16:30
Pyruvic Acid (C3)	<0.1 mg/l	0.1	1F32535	HPLC/UV	
Lactic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV HPLC/UV	JLH 06/24/03 15:57
Acetic Acid (C2)	<1.0 mg/l	1.0	1F32535		JLH 06/24/03 15:57
Propionic Acid (C3)	<1.0 mg/l	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:57
Butyric Acid (C4)	<1.0 mg/l	i.0		HPLC/UV	JLH 06/24/03 15:57
	110 1115/1	1.0	1F32535	HPLC/UV	JLH 06/24/03 15:57

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MACTEC E & C - MO 3199 River Port Tech Center St. Louis, MO 63043

Work Order: 13F0789

June 26, 2003 Page 2 of 3

**RPD** 

### Determination of Metabolic Acids - Quality Control Keystone Laboratories, Inc. - Newton

Spike

Source

%REC

Reporting

Analyte	Result	Limit	Units	Level	Result	%REC	Limits	RPD	Limit	Notes
Batch 1F32535 - General Prep HPLC	С/ІС									
Blank (1F32535-BLK1)				Prepared	& Analyze	ed: 06/24/0	03			
Pyruvic Acid (C3)	ND	0.1	mg/l							
Lactic Acid (C3)	ND	1.0	11							
Acetic Acid (C2)	ND	1.0	"							
Propionic Acid (C3)	ND	1.0	"							
Butyric Acid (C4)	ND	1.0	n							
LCS (1F32535-BS1)				Prepared	& Analyze	ed: 06/24/0	03			
Pyruvic Acid (C3)	36.60	0.1	mg/l	36.75		99.6	81-136			······································
Lactic Acid (C3)	180.4	1.0	**	203.7		88.6	64-134			
Acetic Acid (C2)	166.6	1.0	**	150.7		111	82-122			
Propionic Acid (C3)	169.0	1.0	n	162.4		104	90-112			
Butyric Acid (C4)	155.0	1.0	11	152.4		102	88-113			
Calibration Check (1F32535-CCV1)				Prepared	& Analyze	ed: 06/24/0	03			
Pyruvic Acid (C3)	29.34	0.1	mg/l	28.00		105	80-120			
Lactic Acid (C3)	94.35	1.0	•	98.94		95.4	80-120			
Acetic Acid (C2)	103.1	1.0	**	91.68		112	80-120			
Propionic Acid (C3)	102.3	1.0	Ħ	94.60		108	80-120			
Butyric Acid (C4)	123.7	1.0	**	114.2		108	80-120			
Calibration Check (1F32535-CCV2)				Prepared	& Analyze	ed: 06/24/0	)3			
Pyruvic Acid (C3)	29.42	0.1	mg/l	28.00		105	80-120		***************************************	
Lactic Acid (C3)	96.81	1.0	**	98.94		97.8	80-120			
Acetic Acid (C2)	97.84	1.0	**	91.68		107	80-120			
Propionic Acid (C3)	99.95	1.0	H	94.60		106	80-120			
Butyric Acid (C4)	115.5	1.0	"	114.2		101	80-120			
Matrix Spike (1F32535-MS1)	So	ource: 13F093	3-01	Prepared	& Analyze	ed: 06/24/0	)3			
Pyruvic Acid (C3)	26.45	0.1	mg/l	24.50	ND	108	85-149	- Aller and a		
Lactic Acid (C3)	129.2	1.0	"	135.8	ND	95.1	61-140			
Acetic Acid (C2)	116.3	1.0	H	100.5	ND	116	68-145			
Propionic Acid (C3)	117.2	1.0	**	108.3	ND	108	76-140			
Butyric Acid (C4)	110.1	1.0	**	101.6	ND	108	79-132			

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.







MACTEC E & C - MO 3199 River Port Tech Center St. Louis, MO 63043

Work Order: 13F0789

June 26, 2003

Page 3 of 3

## Determination of Metabolic Acids - Quality Control Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1F32535 - General Prep HPLC	<b>ЭЛС</b>									
Matrix Spike Dup (1F32535-MSD1)	So	urce: 13F093	33-01	Prepared	& Analyz	ed: 06/24/0	03			
Pyruvic Acid (C3)	26.10	0.1	mg/l	24.50	ND	107	85-149	1.33	15	
Lactic Acid (C3)	130.5	1.0	**	135.8	ND	96.1	61-140	1.00	10	
Acetic Acid (C2)	116.6	1.0	"	100.5	ND	116	68-145	0.258	23	
Propionic Acid (C3)	121.5	1.0	**	108.3	ND	112	76-140	3.60	12	
Butyric Acid (C4)	110.7	1.0	**	101.6	ND	109	79-132	0.543	21	

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference

End of Report

Keystone Laboratories, Inc.

Jeffrey King, Ph.D. Laboratory Director

## UHAIN OF UUICUY KEUJRU

161	ysto	ne
LABOR	A T O R I E S	INC.

600 E. 17<sup>th</sup> St. S. Newton, IA 50208

Phone: 641-792-8451 Fax: 641-792-7989 3012 Ansborough Ave. Waterloo, IA 50701

Phone: 319-235-4440 Fax: 319-235-2480 ☐ 1304 Adams

Kansas City, KS 66103 Phone: 913-321-7856 Fax: 913-321-7937

PAGE\_\_\_OF\_\_\_

ADDRESS:	REPORT TO:  NAME: DETUNIS BRINKLEY  COMPANY NAME: MACTEC  ADDRESS: 399 RIVERPORT TECH COSTER DR  CITY/ST/ZIP: ST LOUIS MO 43043  PHONE: (314) 209-5900	BILL TO: NAME:  COMPANY NAME:  ADDRESS:  CITY/ST/ZIP:  PHONE:
PHONE:	FAX: (314) 209-5929	Keystone Quote No.:(If Applicable)

								ANA	ALYSES RE	QUIRE	)	LAB USE	ONLY
				RS		ا ا	N					LABORATORY WORK ORDER N	0.
				AINE		SITE	Acins					13F078	7
CLIENT SAMPLE NUMBER	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	MATRIX	GRAB/COMPOSITE	MOTABOUK					SAMPLE TEMPERATURE UPON RECEIPT:  °C  SAMPLE CONDITION/COMMENTS	LABORATORY SAMPLE NUMBER
MW3BW	6 18 03	1230		1	Gw		X						01
MW3AW	6/18/03			1	6W		X						02
		1630		i	60		X						<i>a</i> 3
7.10.00	1,4,4-9	10.00											
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/ /							
Relinquished by:	Signature	e) 01/8/03	Received by: (Signature)	Date	Turn-Around:	Rush	
> ALS	·	Time 1900		Time	Standard	- Nusii	Contact Lab Prior to Submission
Relinquished by:	(Signature		Received for Lab by: (Signature)	Date 19-03	Remarks:		
_		Time	So	Time 9:42			
L			Original - Return with Report . Y	ellow - Lab Copy •	Pink - Sampler Copy		FORM: CCR 7



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO 3199 Riverport Tech Center Drive St. Louis, MO 63043

January 20, 2004

Site ID :

ESC Sample # : L141005-01

Project #: 3250035046

Date Received : January 15, 2004 Description : GW - Boeing

Sample ID

MW3AW

Collected By : Jack E Friesner Collection Date : 01/14/04 14:15

arameter	Result	Det. Limit	Units	Method	Date	Dil
Methane	BDL	1.0	ppm	8015M	01/15/04	1
Chloride	690	5.0	mq/l	9056	01/16/04	5
Nitrate	BDL	0.10	mg/1	9056	01/16/04	1
Nitrite	BDL	0.10	mq/1	9056	01/16/04	1
Sulfate	92.	5.0	mg/1	9056	01/16/04	1
Free Carbon Dioxide	180	20.	mg/l	406B	01/15/04	2
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	2.6	1.0	mg/l	5310B	01/19/04	1
Sulfide	BDL	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	1.4	1.0	mg/l	9060	01/15/04	1
Iron	BDL	0.050	mg/l	6010B	01/16/04	1
Iron, Dissolved	0.053	0.050	mg/l	6010B	01/17/04	ī
Manganese, Dissolved	0.96	0.010	mg/1	6010B	01/17/04	1
olatile Organics						
Acetone	$\mathtt{BDL}$	0.050	mq/l	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	BDL	0.050	mg/1	8260B	01/15/04	1
Benzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromoform	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromomethane	BDL	0.0010	mg/l	8260B		1
n-Butylbenzene	BDL	0.0010	mg/1	8260B	01/15/04 01/15/04	1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B		
tert-Butylbenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/1	8260B	01/15/04	1
Chlorobenzene	BDL	0.0010			01/15/04	1
Chlorodibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
	ביטנו	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO

3199 Riverport Tech Center Drive St. Louis, MO 63043

January 15, 2004 Date Received :

Description :

GW - Boeing

Sample ID

MW3AW

Collected By : Jack E Friesner
Collection Date : 01/14/04 14:15

Jack E Friesner

Site ID :

January 20, 2004

Project # : 3250035046

ESC Sample # : L141005-01

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
o dil mathal minul other	BDL	0.050	mg/l	8260B	01/15/04	1
2-Chloroethyl vinyl ether	BDL	0.0050	mg/l	8260B	01/15/04	1
Chloroform	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
4-Chlorotoluene	BDL	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromo-3-Chloropropane	BDL	0.0020	mg/l	8260B	01/15/04	1
1,2-Dibromoethane	BDL	0.0010	mq/1	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1 1
1,2-Dichlorobenzene		0.0010	mg/1	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,4-Dichlorobenzene	BDL		mg/l	8260B	01/15/04	ī
Dichlorodifluoromethane	BDL	0.0010		8260B	01/15/04	ī
1,1-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,1-Dichloroethene	0.0015	0.0010	mg/l		01/15/04	1
cis-1,2-Dichloroethene	0.46	0.0010	mg/l	8260B	01/15/04	ī
trans-1,2-Dichloroethene	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	i
1,2-Dichloropropane	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloropropene	BDL	0.0010	mg/l	8260B		1
1,3-Dichloropropane	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	
cis-1,3-Dichloropropene	BDL	0.0010	mg/1	8260B	01/15/04	1
trans-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B	01/15/04	1
2.2-Dichloropropane	BDL	0.0010	mg/1	8260B	01/15/04	1
Di-isopropyl ether	BDL	0.0010	mg/1	8260B	01/15/04	1
Ethylbenzene	$\mathtt{BDL}$	0.0010	mg/l	8260B	01/15/04	1
Hexachlorobutadiene	BDL	0.0010	mg/l	8260B	01/15/04	1
Isopropylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
p-Isopropyltoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
2-Butanone (MEK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methylene Chloride	BDL	0.0050	mg/l	8260B	01/15/04	1
4-Methyl-2-pentanone (MIBK)	BDL	0.050	mg/l	8260B	01/15/04	1
Methyl tert-butyl ether	BDL	0.0010	mg/1	8260B	01/15/04	1
Naphthalene	BDL	0.0050	mg/1	8260B	01/15/04	1
	BDL	0.0010	mg/1	8260B	01/15/04	1
n-Propylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Styrene	BDL	0.0010	mg/1	8260B	01/15/04	1
1,1,1,2-Tetrachloroethane	BDL	0.0010	mq/1	8260B	01/15/04	1
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/1	8260B	01/15/04	1
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/1	8260B	01/15/04	1
Tetrachloroethene	חתם	0.0010			, ,	

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO

3199 Riverport Tech Center Drive St. Louis, MO 63043

:

January 20, 2004

Site ID :

ESC Sample # : L141005-01

Project #: 3250035046

Date Received :

January 15, 2004 GW - Boeing

Description

Sample ID

MW3AW

Collected By Collection Date :

Jack E Friesner

01/14/04 14:15

Parameter	Result	Det. Limit	Units	Method	Date	Dil
Toluene	BDL	0.0050	mg/l	8260B	07/75/04	
1,2,3-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010			01/15/04	1
1,1,1-Trichloroethane	BDL		mg/l	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	_	0.0010	mg/l	8260B	01/15/04	1
Trichlorofluoromethane	0.29	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mg/1	8260B	01/15/04	1
1,2,4-IIImethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Vinyl chloride	0.013	0.0010	mq/l	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mg/l	8260B	01/15/04	1
rrogate Recovery			3/ ~	02005	01/13/04	1
Toluene-d8	98.		% Rec.	8260B	01/15/04	
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.		01/15/04	Ţ
	100		· rec.	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

The reported analytical results relate only to the sample submitted.

This report shall not be reproduced, except in full, without the written approval from ESC.

Reported: 01/20/04 09:23 Printed: 01/20/04 15:02

ESC Representative



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO 3199 Riverport Tech Center Drive St. Louis, MO 63043

January 20, 2004

Site ID :

ESC Sample # : L141005-02

Project #: 3250035046

Date Received :

January 15, 2004

Description :

GW - Boeing

Sample ID

: MW3BW

Collected By : Jack E Friesner Collection Date : 01/14/04 12:35

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Methane	BDL	1.0	ppm	8015M	01/15/04	1
	1400	10.	mg/l	9056	01/16/04	10
Chloride	BDL	0.10	mg/l	9056	01/16/04	1
Nitrate	BDL	0.10	mg/1	9056	01/16/04	1
Nitrite	33.	5.0	mg/l	9056	01/16/04	1
Sulfate	33.	3.0	9/ =	3020	• ,	
Free Carbon Dioxide	120	10.	mg/l	406B	01/15/04	1
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	1.4	1.0	mg/l	5310B	01/19/04	1
Sulfide	BDL	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	BDL	1.0	mg/l	9060	01/15/04	1
toe (toear organico carron,						
Iron	16.	0.050	$\mathfrak{m} g/1$	6010B	01/16/04	1
Iron, Dissolved	11.	0.050	mg/1	6010B	01/17/04	1
Manganese, Dissolved	6.7	0.010	mg/l	6010B	01/17/04	1
Volatile Organics					/ /0.	
Acetone	BDL	0.050	mg/1	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	1
Acrylonitrile	BDL	0.050	mg/l	8260B	01/15/04	1
Benzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromoform	BDL	0.0010	mg/1	8260B	01/15/04	1
Bromomethane	BDL	0.0010	mg/1	8260B	01/15/04	1
n-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
sec-Butylbenzene	$\mathtt{BDL}$	0.0010	mg/1	8260B	01/15/04	1.
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/1	8260B	01/15/04	1
Chlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Chlorodibromomethane	BDL	0.0010	mg/1	8260B	01/15/04	1
Chloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

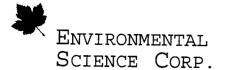
Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Page 4 of 20



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley
MACTEC - St. Louis, MO

3199 Riverport Tech Center Drive St. Louis, MO 63043

ESC Sample # : L141005-02

Date Received : January 15

January 15, 2004

Site ID :

January 20, 2004

Sample ID

MW3BW

Project # : 3250035046

Collected By : Jack E Friesner Collection Date : 01/14/04 12:35

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
2-Chloroethyl vinyl ether	BDL	2 252			2400	D11.
Chloroform	BDL	0.050	mg/l	8260B	01/15/04	1
Chloromethane	BDL	0.0050	mg/l	8260B	01/15/04	1
2-Chlorotoluene	BDL	0.0010	mg/l	8260B	01/15/04	1
4-Chlorotoluene	BDL	0.0010	mg/1	8260B	01/15/04	1
1,2-Dibromo-3-Chloropropane		0.0010	mg/l	8260B	01/15/04	1
1,2-Dibromoethane	BDL	0.0020	mg/l	8260B	01/15/04	1
Dibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	ī
1,4-Dichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Dichlorodifluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1-Dichloroethane	$\mathtt{BDL}$	0.0010	mg/l	8260B		ī
	BDL	0.0010	mg/l	8260B		1
1,2-Dichloroethane	$\mathtt{BDL}$	0.0010	mg/l	8260B		1
1,1-Dichloroethene	$\mathtt{BDL}$	0.0010	mg/l	8260B		1
cis-1,2-Dichloroethene	0.0062	0.0010	mg/l	8260B		1
trans-1,2-Dichloroethene	BDL	0.0010	mg/l	8260B		1
1,2-Dichloropropane	BDL	0.0010	mg/l	8260B		
1,1-Dichloropropene	BDL	0.0010	mg/l	8260B		1
1,3-Dichloropropane	$\mathtt{BDL}$	0.0010	mg/l	8260B		
cis-1,3-Dichloropropene	BDL	0.0010	mg/l	8260B		1
trans-1,3-Dichloropropene	$\mathtt{BDL}$	0.0010	mg/l	8260B		1
2,2-Dichloropropane	BDL	0.0010	mg/1	8260B		1
Di-isopropyl ether	$\mathtt{BDL}$	0.0010	mg/l	8260B		1
Ethylbenzene	BDL	0.0010	mg/l	8260B		1
Hexachlorobutadiene	BDL	0.0010	mg/l	8260B		1
Isopropylbenzene	BDL	0.0010	mg/1	8260B		1
p-Isopropyltoluene	BDL	0.0010	mg/1	8260B		1
2-Butanone (MEK)	BDL	0.050	mg/1			1
Methylene Chloride	BDL	0.0050	mq/l	8260B		1
4-Methyl-2-pentanone (MIBK)	BDL	0.050		8260B		1
Methyl tert-butyl ether	BDL	0.0010	mg/l	8260B		1
Naphthalene	BDL	0.0010	mg/1	8260B		1
n-Propylbenzene	BDL	0.0010	mg/l	8260B		1
Styrene	BDL	0.0010	mg/l	8260B		1
1,1,1,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B		1
1,1,2,2-Tetrachloroethane	BDL	0.0010	mg/l	8260B		1
1,1,2-Trichloro-1,2,2-trifluoro	BDL	0.0010	mg/l	8260B		1
Tetrachloroethene	BDL	0.0010	mg/1	8260B		1
PDI Delem Delem Delem de	200	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley

MACTEC - St. Louis, MO

3199 Riverport Tech Center Drive St. Louis, MO 63043

:

January 15, 2004

Date Received : Description

GW - Boeing

Sample ID

MW3BW

Collected By : Collection Date :

Jack E Friesner 01/14/04 12:35

ESC Sample # : L141005-02

Site ID :

January 20, 2004

Project # : 3250035046

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Toluene	BDL	0.0050	mg/l	8260B	01/15/04	1
1.2.3-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1.1.1-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1.1.2-Trichloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Trichloroethene	BDL	0.0010	mq/l	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mq/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mq/1	8260B	01/15/04	1
Vinyl chloride	0.0018	0.0010	mq/l	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mq/l	8260B	01/15/04	1
Surrogate Recovery			٥.			
Toluene-d8	100		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233 Note:

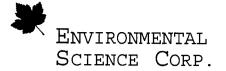
The reported analytical results relate only to the sample submitted.

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Reported: 01/20/04 09:23 Printed: 01/20/04 15:02

Page 6 of 20

Representative



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO 3199 Riverport Tech Center Drive St. Louis, MO 63043

Project # : 3250035046

ESC Sample # : L141005-03

January 20, 2004

Site ID :

Date Received : January 15, 2004 Description : GW - Boeing

Sample ID

MW3W

Collected By : Jack E Friesner Collection Date : 01/14/04 16:30

Jack E Friesner

Parameter	Result	Det. Limit	Units	Method	Date	Dil
Methane	1.6	1.0	ppm	8015M	01/15/04	1
Chloride	480	5.0	mg/l	9056	01/16/04	5
Nitrate	BDL	0.10	mg/1	9056	01/16/04	1
Nitrite	BDL	0.10	mg/1	9056	01/16/04	1
Sulfate	41.	5.0	mg/1	9056	01/16/04	1
Free Carbon Dioxide	140	50.	mg/l	406B	01/15/04	5
Ethane	BDL	10.	ppm	8015M	01/15/04	1
Ethene	BDL	10.	ppm	8015M	01/15/04	1
DOC	2.0	1.0	mg/l	5310B	01/19/04	1
Sulfide	0.077	0.050	mg/l	9030B	01/16/04	1
TOC (Total Organic Carbon)	1.7	1.0	mg/l	9060	01/15/04	1
Iron	5.8	0.050	mg/l	6010B	01/16/04	1
Iron, Dissolved	0.70	0.050	mg/1	6010B	01/17/04	ī
Manganese, Dissolved	2.1	0.010	mg/l	6010B	01/17/04	ī
olatile Organics						
Acetone	BDL	0.050	mg/l	8260B	01/15/04	1
Acrolein	BDL	0.050	mg/l	8260B	01/15/04	ī
Acrylonitrile	BDL	0.050	mg/l	8260B	01/15/04	ī
Benzene	BDL	0.0010	mq/1	8260B	01/15/04	ī
Bromobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Bromodichloromethane	BDL	0.0010	mq/l	8260B	01/15/04	1
Bromoform	BDL	0.0010	mq/l	8260B	01/15/04	ī
Bromomethane	BDL	0.0010	mg/1	8260B	01/15/04	ī
n-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
sec-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	ī
tert-Butylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Carbon tetrachloride	BDL	0.0010	mg/l	8260B	01/15/04	ī
Chlorobenzene	BDL	0.0010	mg/1	8260B	01/15/04	ī
Chlorodibromomethane	BDL	0.0010	mg/l	8260B	01/15/04	1
Chloroethane	BDL	0.0010	mg/l	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley MACTEC - St. Louis, MO 3199 Riverport Tech Center Drive St. Louis, MO 63043

January 20, 2004

ESC Sample # : L141005-03

Date Received : January 15, 2004

Description GW - Boeing

Site ID :

Sample ID MW3W

Project # : 3250035046

Collected By : Jack E Friesner Collection Date : 01/14/04 16:30 Jack E Friesner

2-Chloroethyl vinyl ether       BDL       0.050       mg/         Chloroform       BDL       0.0050       mg/         Chloromethane       BDL       0.0010       mg/         2-Chlorotoluene       BDL       0.0010       mg/         4-Chlorotoluene       BDL       0.0010       mg/         1,2-Dibromo-3-Chloropropane       BDL       0.0020       mg/         1,2-Dibromoethane       BDL       0.0010       mg/         Dibromomethane       BDL       0.0010       mg/         1,2-Dichlorobenzene       BDL       0.0010       mg/	1 8260B 1 8260B	01/15/04	-
Chloroform         BDL         0.0050         mg/           Chloromethane         BDL         0.0010         mg/           2-Chlorotoluene         BDL         0.0010         mg/           4-Chlorotoluene         BDL         0.0010         mg/           1,2-Dibromo-3-Chloropropane         BDL         0.0020         mg/           1,2-Dibromoethane         BDL         0.0010         mg/           Dibromomethane         BDL         0.0010         mg/           1,2-Dichlorobenzene         BDL         0.0010         mg/	1 8260B 1 8260B		1
2-Chlorotoluene       BDL       0.0010       mg/         4-Chlorotoluene       BDL       0.0010       mg/         1,2-Dibromo-3-Chloropropane       BDL       0.0020       mg/         1,2-Dibromoethane       BDL       0.0010       mg/         Dibromomethane       BDL       0.0010       mg/         1,2-Dichlorobenzene       BDL       0.0010       mg/		01/15/04	1
2-Chlorotoluene       BDL       0.0010       mg/:         4-Chlorotoluene       BDL       0.0010       mg/:         1,2-Dibromo-3-Chloropropane       BDL       0.0020       mg/:         1,2-Dibromoethane       BDL       0.0010       mg/:         Dibromomethane       BDL       0.0010       mg/:         1,2-Dichlorobenzene       BDL       0.0010       mg/:		01/15/04	1
4-Chlorotoluene       BDL       0.0010       mg/:         1,2-Dibromo-3-Chloropropane       BDL       0.0020       mg/:         1,2-Dibromoethane       BDL       0.0010       mg/:         Dibromomethane       BDL       0.0010       mg/:         1,2-Dichlorobenzene       BDL       0.0010       mg/:		01/15/04	1
1,2-Dibromo-3-Chloropropane       BDL       0.0020       mg/:         1,2-Dibromoethane       BDL       0.0010       mg/:         Dibromomethane       BDL       0.0010       mg/:         1,2-Dichlorobenzene       BDL       0.0010       mg/:	1 8260B	01/15/04	ī
1,2-Dibromoethane       BDL       0.0010       mg/3         Dibromomethane       BDL       0.0010       mg/3         1,2-Dichlorobenzene       BDL       0.0010       mg/3		01/15/04	ī
Dibromomethane BDL 0.0010 mg/11,2-Dichlorobenzene BDL 0.0010 mg/1		01/15/04	ī
1,2-Dichlorobenzene BDL 0.0010 mg/		01/15/04	ī
		01/15/04	ī
1,3-Dichlorobenzene BDL 0.0010 mg/		01/15/04	ī
1,4-Dichlorobenzene BDL 0.0010 mg/		01/15/04	ī
Dichlorodifluoromethane BDL 0.0010 mg/		01/15/04	ī
1,1-Dichloroethane BDL 0.0010 mg/		01/15/04	ī
1,2-Dichloroethane BDL 0.0010 mg/	1 8260B	01/15/04	ī
1,1-Dichloroethene 0.014 0.0010 mg/		01/15/04	1
cis-1,2-Dichloroethene 2.6 0.0010 mg/		01/15/04	ī
trans-1,2-Dichloroethene 0.10 0.0010 mg/		01/15/04	ī
1,2-Dichloropropane BDL 0.0010 mg/		01/15/04	ī
1,1-Dichloropropene BDL 0.0010 mg/		01/15/04	ī
1,3-Dichloropropane BDL 0.0010 mg/		01/15/04	ī
cis-1,3-Dichloropropene BDL 0.0010 mg/		01/15/04	1
trans-1,3-Dichloropropene BDL 0.0010 mg/		01/15/04	1
2,2-Dichloropropane BDL 0.0010 mg/:		01/15/04	1
Di-isopropyl ether BDL 0.0010 mg/:		01/15/04	1
Ethylbenzene BDL 0.0010 mg/:		01/15/04	1
Hexachlorobutadiene BDL 0.0010 mg/		01/15/04	1
Isopropylbenzene BDL 0.0010 mg/:		01/15/04	1
p-Isopropyltoluene BDL 0.0010 mg/	1 8260B	01/15/04	1
2-Butanone (MEK) BDL 0.050 mg/:		01/15/04	ī
Methylene Chloride BDL 0.0050 mg/:	1 8260B	01/15/04	
4-Methyl-2-pentanone (MIBK) BDL 0.050 mg/:		01/15/04	1
Methyl tert-butyl ether BDL 0.0010 mg/		01/15/04	1
Naphthalene BDL 0.0050 mg/:		01/15/04	1
n-Propylbenzene BDL 0.0010 mg/		01/15/04	1
Styrene BDL 0.0010 mg/		01/15/04	ī
1,1,1,2-Tetrachloroethane BDL 0.0010 mg/:		01/15/04	ī
1,1,2,2-Tetrachloroethane BDL 0.0010 mg/:		01/15/04	ī
1,1,2-Trichloro-1,2,2-trifluoro BDL 0.0010 mg/:		01/15/04	1
Tetrachloroethene BDL 0.0010 mg/	l 8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Page 8 of 20



Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Dennis Brinkley

MACTEC - St. Louis, MO 3199 Riverport Tech Center Drive St. Louis, MO 63043

ESC Sample # : L141005-03

Project #: 3250035046

January 20, 2004

Site ID :

Date Received :

January 15, 2004 :

Description

GW - Boeing

Sample ID

MW3W

Collected By : Collection Date :

Jack E Friesner 01/14/04 16:30

arameter	Result	Det. Limit	Units	Method	Date	Dil
Toluene	BDL	0.0050	mg/l	8260B	01/15/04	1
1,2,3-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trichlorobenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,1,1-Trichloroethane	BDL	0.0010	mg/1	8260B	01/15/04	1
1,1,2-Trichloroethane	BDL	0.0010	mg/1	8260B	01/15/04	1
Trichloroethene	0.034	0.0010	mq/1	8260B	01/15/04	1
Trichlorofluoromethane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trichloropropane	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,4-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,2,3-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
1,3,5-Trimethylbenzene	BDL	0.0010	mg/l	8260B	01/15/04	1
Vinyl chloride	1.0	0.0010	mg/l	8260B	01/15/04	1
Xylenes, Total	BDL	0.0030	mg/l	8260B	01/15/04	1
urrogate Recovery			-			
Toluene-d8	100		% Rec.	8260B	01/15/04	1
Dibromofluoromethane	100		% Rec.	8260B	01/15/04	1
4-Bromofluorobenzene	100		% Rec.	8260B	01/15/04	1

BDL - Below Detection Limit

Det. Limit - Estimated Quantitation Limit (EQL)

Laboratory Certification Numbers:

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01

KY - 90010, KYUST - 0016, NC - ENV375, DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233 Note:

The reported analytical results relate only to the sample submitted.

This report shall not be reproduced, except in full, without the written approval from ESC.

Reported: 01/20/04 09:23 Printed: 01/20/04 15:02

Representative

### Attachment A List of Analytes with QC Qualifiers

Sample #	Analyte	Qualifier
L141005-01	DOC	₩ J4
	Chloride	J4 J4
	Acrolein Bromodichloromethane	J3
		J3
	Bromomethane	J4J3
	2-Chloroethyl vinyl ether	J3
	Dibromomethane	E
	cis-1,2-Dichloroethene	J3
	1,2-Dichloropropane	J3
	2-Butanone (MEK)	J3
	4-Methyl-2-pentanone (MIBK) Trichloroethene	E
L141005-02	1,2,3-Trichloropropane DOC	W
1141005-02	Chloride	,, J4
	Nitrite	L Q
	Acrolein	J4J5
	Acrylonitrile	J3
	2-Chloroethyl vinyl ether	J4
	2-Butanone (MEK)	J3
	Methyl tert-butyl ether	J5
	1,1,2,2-Tetrachloroethane	J3
L141005-03	DOC	W
2212003 03	Chloride	J4
	Acrolein	J4
	Bromodichloromethane	J3
	Bromomethane	J3
	2-Chloroethyl vinyl ether	J4J3
	Dibromomethane	<b>J</b> 3
	cis-1,2-Dichloroethene	E
	1,2-Dichloropropane	J3
	2-Butanone (MEK)	J3
	4-Methyl-2-pentanone (MIBK)	<b>J</b> 3
	1,2,3-Trichloropropane	J3
	Vinyl chloride	E

#### Attachment B Explanation of QC Qualifier Codes

Qualifier	Meaning
E	GTL (EPA) - Greater than upper calibration limit: Actual value is known to be greater than the upper calibration range.
J3	The associated batch QC was outside the established quality control range for precision.
J4	The associated batch QC was outside the established quality control range for accuracy.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high
Q	(ESC) Sample held beyond the accepted holding time.
L	(ESC)Sample Pretreatment: The sample reaction impaired the ability to analyze the sample using normal analytical determination. Treatment outside of method protocol was required to determine the analytical result.
W	(ESC)-The laboratory analysis was from a sample collected in an improper container

#### Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods, it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable unless qualified as 'R' (Rejected).

#### Definitions

- Accuracy The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.
- Precision The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Differrence.
- Surrogate Organic compounds that are similar in chemical composition, extraction, and chromotography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

  Control Limits
- 2-Fluorophenol 31-119 Nitrobenzene-d5 Nitrobenzene-d5 43-118 2-Fluorobiphenyl 45-128 Dibromfluoromethane 79-126 83-119 Phenol-d5 12-134 Toluene-d8 81-114 82-116 2,4,6-Tribromophenol 51-141 43-137 4-Bromofluorobenzene 65-129 72-126 Terphenyl-d14
- Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

## Summary of Remarks For Samples Printed 01/20/04 at 15:02:58

TSR Signing Reports: 206 R5 - Desired TAT

Needs EDD in PPB format.

Sample: L141005-01 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23

Needs EDD PPM FORMAT

Sample: L141005-02 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23

Needs EDD PPM FORMAT

Sample: L141005-03 Account: HARDMO Received: 01/15/04 09:30 Due Date: 01/22/04 00:00 RPT Date: 01/20/04 09:23

Needs EDD PPM FORMAT



Tax I.D. 62-0814289

Est. 1970

MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

St. Louis, MO 63043

Quality Assurance Report Level II

L141005

January 20, 2004

Analyte	Pogul +	Labora	tory Blan		Da 6 al-
ENTALY CC	Result		Units	Date Analyzed	Batch
Nitrate	< .1		mg/l	01/15/04 18:08	WG140525
Nitrite	< .1		mq/l	01/15/04 18:08	WG140525
Sulfate	< 5		mg/l	01/15/04 18:08	WG140525
			₹*		
TOC (Total Organic Carbon)	< 1		mg/1	01/15/04 13:17	WG140588
Iron	< .05		m~/1	01:/15/04 00 10	- TOTA 0 01 0
11011	< .05		mg/l	01/16/04 02:18	WG140610
Free Carbon Dioxide	< 10		mg/l	01/15/04 17:30	WG140619
			J.		
1,1,1,2-Tetrachloroethane	< .001		mg/l	01/15/04 14:36	WG140662
1,1,1-Trichloroethane	< .001		mg/l	01/15/04 14:36	WG140662
1,1,2,2-Tetrachloroethane	< .001		mg/l	01/15/04 14:36	WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	< .001		mg/l	01/15/04 14:36	WG140662
1,1,2-Trichloroethane	< .001		mg/1	01/15/04 14:36	WG140662
1,1-Dichloroethane	< .001		mg/l	01/15/04 14:36	WG140662
1,1-Dichloroethene	< .001		mg/l	01/15/04 14:36	WG140662
1,1-Dichloropropene	< .001		mg/l	01/15/04 14:36	WG140662
1,2,3-Trichlorobenzene	< .001		mg/1	01/15/04 14:36	WG140662
1,2,3-Trichloropropane	< .001		mg/l	01/15/04 14:36	WG140662
1,2,3-Trimethylbenzene	< .001		mg/l	01/15/04 14:36	WG140662
1,2,4-Trichlorobenzene	< .001		mg/l	01/15/04 14:36	WG140662
1,2,4-Trimethylbenzene	< .001		mg/l	01/15/04 14:36	WG140662
1,2-Dibromo-3-Chloropropane	< .002		mg/l	01/15/04 14:36	WG140662
1,2-Dibromoethane	< .001		mg/l	01/15/04 14:36	WG140662
1,2-Dichlorobenzene	< .001		mg/l	01/15/04 14:36	WG140662
1,2-Dichloroethane	< .001		mg/l	01/15/04 14:36	WG140662
1,2-Dichloropropane	< .001	- LE 145	mg/l	01/15/04 14:36	WG140662
1,3,5-Trimethylbenzene	< .001		mg/l	01/15/04 14:36	WG140662
1,3-Dichlorobenzene	< .001		mg/l	01/15/04 14:36	WG140662
1,3-Dichloropropane	< .001		mg/l	01/15/04 14:36	WG140662
1,4-Dichlorobenzene	< .001		mg/l	01/15/04 14:36	WG140662
2,2-Dichloropropane	< .001		mg/l	01/15/04 14:36	WG140662
2-Butanone (MEK)	< .05		mg/l	01/15/04 14:36	WG140662
2-Chloroethyl vinyl ether	< .05		mg/l	01/15/04 14:36	WG140662
2-Chlorotoluene	< .001		mg/l	01/15/04 14:36	WG140662
4-Chlorotoluene	< .001		mg/l	01/15/04 14:36	WG140662
4-Methyl-2-pentanone (MIBK)	< .05		mg/1	01/15/04 14:36	WG140662
Acetone	< .05		mg/l	01/15/04 14:36	WG140662
Acrolein	< .05		mg/l	01/15/04 14:36	WG140662
Acrylonitrile	< .05		mg/l	01/15/04 14:36	WG140662
Benzene	< .001		mg/1	01/15/04 14:36	WG140662
Bromobenzene	< .001		mg/l	01/15/04 14:36	WG140662
Bromodichloromethane	< .001		mg/l	01/15/04 14:36	WG140662
Bromoform	< .001		mg/l	01/15/04 14:36	WG140662
Bromomethane	< .001		mg/l	01/15/04 14:36	WG140662
Carbon tetrachloride	< .001		mg/l	01/15/04 14:36	WG140662
Chlorobenzene	< .001		mg/l	01/15/04 14:36	WG140662
Chlorodibromomethane Chloroethane	< .001		mg/l	01/15/04 14:36	WG140662
Chloroform	< .001		mg/l	01/15/04 14:36	WG140662
	< .005		mg/l	01/15/04 14:36	WG140662
Chloromethane cis-1,2-Dichloroethene	< .001		mg/l	01/15/04 14:36	WG140662
	< .001		mg/l	01/15/04 14:36	WG140662
cis-1,3-Dichloropropene Di-isopropyl ether	< .001		mg/1	01/15/04 14:36	WG140662
Dibromomethane	< .001		mg/l	01/15/04 14:36	WG140662
	< .001		mg/l	01/15/04 14:36	WG140662
Dichlorodifluoromethane	< .001		mg/l	01/15/04 14:36	WG140662
Ethylbenzene Hexachlorobutadiene	< .001		mg/l	01/15/04 14:36	WG140662
TICVACITIOTODICAGIEIIE	< .001		mg/1	01/15/04 14:36	WG140662
Isopropylbenzene	< .001		mg/l	01/15/04 14:36	WG140662



Tax I.D. 62-0814289

Est. 1970

MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

Quality Assurance Report Level II

St. Louis, MO 63043

L141005

January 20, 2004

Methyl tert-butyl ether	< .001	mg/l	01/15/04 14:36	WG140662	
Apalyto		aboratory Blan		Patah	
Analyte  Methylene Chloride n-Butylbenzene n-Propylbenzene Naphthalene p-Isopropyltoluene sec-Butylbenzene Styrene tert-Butylbenzene Tetrachloroethene Toluene trans-1,2-Dichloroethene trans-1,3-Dichloropropene Trichloroethene Trichlorofluoromethane Vinyl chloride Xylenes, Total Iron,Dissolved Manganese,Dissolved	Result  < .005 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001 < .001	Units  mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg/	Date Analyzed  01/15/04 14:36	WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662	
Chloride Nitrite	< 1	mg/l mg/l	01/16/04 18:17 01/16/04 18:17	WG140706 WG140706	
Sulfide DOC	< .05 < 1	mg/l	01/16/04 15:00	WG140829	
200	<u> </u>	mg/l	01/19/04 11:44	WG140996	—
Analyte	Units R	Duplicate esult Duplica	te RPD Limi	t Ref Samp Batc	:h_
Nitrate Nitrite Sulfate	mg/l 0 mg/l 40		0.00 20 0.585 20	L141005-03 WG14	10525 10525
TOC (Total Organic Carbon)	<u>.</u>	.00 0.00	0.00 20		10588
Free Carbon Dioxide	J.	. 120.		L141005-02 WG14	0619
Sulfide	mg/1 0	.0848 0.077	0 9.64 20	L141005-03 WG14	10829
DOC	mg/l 1	.23 1.40	13.0 20	L141005-02 WG14	<u>109</u> 96
Analyte		tory Control S Known Val R	ample esult % Re	c Limit Batch	
Nitrate Nitrite Sulfate	mg/l	4 3	.68 92. .55 88. .7 88.	8 85-115 WG14052	25
TOC (Total Organic Carbon)	mg/l	4 4	.40 110.	85-115 WG14058	8 8
Iron	mg/l	1.13 1	.04 92.	0 85-115 WG14061	. 0
1,1,1,2-Tetrachloroethane 1,1,1-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1,2-Trichloro-1,2,2-trifluoroethane 1,1,2-Trichloroethane 1,1-Dichloroethane	mg/l mg/l mg/l mg/l	.02 0 .02 0 .02 0 .02 0	.0211 105. .0181 90. .0210 105. .0157 78. .0190 95. .0188 94.	5 71-122 WG14066 78-120 WG14066 5 37-127 WG14066 2 82-117 WG14066	52 52 52 52



Tax I.D. 62-0814289

Est. 1970

MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

St. Louis, MO 63043

Quality Assurance Report

L141005

Level II

January 20, 2004

1,1-Dichloroethene	mg/l	. 02	0.0182	90.8	60-166	WG140662
no luto		ratory Control		9 75	T 3 3 E	P - 4 - 1
Analyte	Units	Known Val	Result	% Rec	Limit	Batch
1,1-Dichloropropene	mg/l	.02	0.0172	85.8	67-132	WG140662
1,2,3-Trichlorobenzene	mg/1	.02	0.0210	105.	81-122	WG140662
1,2,3-Trichloropropane	mg/l	.02	0.0205	102.	78-122	WG140662
1,2,3-Trimethylbenzene	mg/1	.02	0.0169		64-100	WG140662
1,2,4-Trichlorobenzene	mg/l	.02	0.0214	107.	78-132	WG140662
1,2,4-Trimethylbenzene	mg/l	. 02	0.0204	102.	82-117	WG140662
1,2-Dibromo-3-Chloropropane	mg/l	.02	0.0201	101.	58-140	WG140662
1,2-Dibromoethane	mg/l	.02	0.0203	101.	79-121	WG140662
1,2-Dichlorobenzene	mg/l	.02	0.0195	97.3	83-113	WG140662
1,2-Dichloroethane	mg/l	.02	0.0197	98.5	81-122	WG140662
1,2-Dichloropropane 1,3,5-Trimethylbenzene	mg/l	.02	0.0247	124.	74-125	WG140662
1,3-Dichlorobenzene	mg/l mg/l	.02	0.0197	98.4	80-118	WG140662
1,3-Dichloropropane	mg/1	.02 .02	0.0209 0.0202	104. 101.	80-124 86-120	WG140662
1,4-Dichlorobenzene	mg/1	.02	0.0194	97.2	84-115	WG140662 WG140662
2,2-Dichloropropane	mg/1	.02	0.0192	95.9	71-131	WG140662
2-Butanone (MEK)	mg/l	.1	0.106	106.	25-137	WG140662
2-Chloroethyl vinyl ether	mg/l	.1	0.00188	1.88	15-161	WG140662
2-Chlorotoluene	mg/l	.02	0.0192	96.1	79-112	WG140662
4-Chlorotoluene	mg/l	.02	0.0198	99.0	82-116	WG140662
4-Methyl-2-pentanone (MIBK)	mg/l	.1	0.108	108.	57-145	WG140662
Acetone	mg/l	.1	0.0916	91.6	14-115	WG140662
Acrolein	mg/l	. 1	0.201	201.	16-83	WG140662
Acrylonitrile	mg/l	. 1	0.0916	91.6	32-142	WG140662
Benzene	mg/l	.02	0.0187	93.3	66-127	WG140662
Bromobenzene	mg/l	.02	0.0207	104.	79-127	WG140662
Bromodichloromethane	mg/l	.02	0.0218	109.	76-117	WG140662
Bromoform	mg/l	.02	0.0220	110.	72-125	WG140662
Bromomethane	mg/l	. 02	0.0102	51.1	25-170	WG140662
Carbon tetrachloride	mg/l	.02	0.0180	89.9	65-127	WG140662
Chlorobenzene Chlorodibromomethane	mg/l	.02	0.0195	97.6	79-117	
Chloroethane	mg/l mg/l	.02	0.0197	98.3	76-115	WG140662
Chloroform		.02 .02	0.0133 0.0191	66.7 95.6	37-130	WG140662
Chloromethane	mg/l mg/l	.02	0.0191	52.0	70-119 39-109	WG140662
cis-1,2-Dichloroethene	mg/1	.02	0.0185	92.5	72-128	WG140662 WG140662
cis-1,3-Dichloropropene	mg/1	.02	0.0210	105.	86-137	WG140662 WG140662
Di-isopropyl ether	mg/1	.02	0.0207	103.	54-147	WG140662
Dibromomethane	mg/l	.02	0.0217	109.	81-117	WG140662
Dichlorodifluoromethane	mg/l	.02	0.00559	28.0	14-133	WG140662
Ethylbenzene	mg/l	.02	0.0187	93.6	75-117	WG140662
Hexachlorobutadiene	mg/l	.02	0.0176	87.8	68-122	WG140662
Isopropylbenzene	mg/1	.02	0.0173	86.5	67-113	WG140662
Methyl tert-butyl ether	mg/l	.02	0.0218	109.	65-128	WG140662
Methylene Chloride	mg/l	.02	0.0191	95.4	60-127	WG140662
n-Butylbenzene	mg/l	.02	0.0188	94.1	74-125	WG140662
n-Propylbenzene	mg/l	.02	0.0191	95.5	74-120	WG140662
Naphthalene	mg/l	.02	0.0183	91.6	51-127	WG140662
p-Isopropyltoluene	mg/l	.02	0.0196	97.9	74-122	WG140662
Sec-Butylbenzene Styrene	mg/l	.02	0.0182	90.9	66-118	WG140662
tert-Butylbenzene	mg/l mg/l	.02 .02	0.0198 0.0201	99.2 101.	78-114 69-121	WG140662
Tetrachloroethene	mg/1	.02	0.0201	93.3	71-132	WG140662 WG140662
Toluene	mg/l	.02	0.0194	97.1	68-122	WG140662 WG140662
trans-1,2-Dichloroethene	mg/1	.02	0.0176	88.0	65-141	WG140662 WG140662
trans-1,3-Dichloropropene	mg/1	.02	0.0178	98.8	82-132	WG140662 WG140662
Trichloroethene	mg/1	.02	0.0181	90.7	81-129	WG140662
Trichlorofluoromethane	mg/l	.02	0.0125	62.7	46-94	WG140662
Vinyl chloride	mg/l	.02	0.0115	57.6	40-95	WG140662
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Tax I.D. 62-0814289

Est. 1970

MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

Quality Assurance Report Level II

St. Louis, MO 63043

L141005

January 20, 2004

Xylenes, Total	mg/l	.06	0.0	574	95.7	78-114	WG140662
Analyte	Lab Units	oratory Co Known V			% Rec	Limit	Batch
Iron,Dissolved Manganese,Dissolved	mg/l mg/l	1.13 1.13	1.1		105. 106.	85-115 85-115	WG140681 WG140681
Chloride Nitrite	mg/l mg/l	20 4	17.0 3.5		85.1 89.1	90-110 85-115	WG140706 WG140706
Sulfide	mg/l	. 5	0.5	3:0.	106.	85-115	WG140829
DOC	mg/l	4	4.6	0	115.	85-115	WG140996
Analyte	Laborato Units	ry Control LCSD Res		uplicate RPD	Limit	Ref Samp	Batch
Nitrate Nitrite Sulfate	mg/l mg/l mg/l	3.62 3.54 17.6	3.68 3.55 17.7	1.59 0.421 0.872	20 20 20	R184382-5 R184382-5 R184382-5	WG140525 WG140525 WG140525
TOC (Total Organic Carbon)	mg/l	4.30	4.40	2.30	20	WG140588-	2 WG140588
Iron	mg/l	1.06	1.04	1.90		R184336-3	WG140610
1,1,1,2-Tetrachloroethane 1,1,1-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1,2-Trichloro-1,2,2-trifluoroethane 1,1,2-Trichloroethane 1,1-Dichloroethane 1,1-Dichloroethene 1,1-Dichloropropene 1,2,3-Trichlorobenzene 1,2,3-Trichloropropane 1,2,3-Trimethylbenzene 1,2,4-Trichlorobenzene 1,2,4-Trimethylbenzene 1,2-Dibromo-3-Chloropropane 1,2-Dibromoethane 1,2-Dichlorobenzene 1,2-Dichloropropane 1,3-Trimethylbenzene 1,2-Dichloropropane 1,2-Dichloropropane 1,2-Dichloropropane 1,2-Dichloropropane 1,3-Dichloropropane 1,3-Dichloropropane 2,2-Dichloropropane 2,2-Dichloropropane 2,2-Dichloropropane 2,4-Dichlorobenzene 2,2-Dichloropropane 4-Chlorotoluene 4-Chlorotoluene 4-Chlorotoluene 4-Chlorotoluene 4-Methyl-2-pentanone (MIBK) Acetone Acrolein Acrylonitrile Benzene Bromobenzene	mg/l mg/l mg/l mg/l mg/ll mg//l mgg/l	0.0208 0.0177 0.0198 0.0151 0.0189 0.0175 0.0168 0.0179 0.0168 0.0210 0.0204 0.0172 0.0198 0.0198 0.0199 0.0198 0.0198 0.0199 0.0198 0.0199 0.0199 0.0199 0.0199 0.0199 0.0199 0.0199 0.0198	0.0211 0.0181 0.0210 0.0157 0.0190 0.0188 0.0182 0.0172 0.0210 0.0205 0.0169 0.0214 0.0204 0.0201 0.0203 0.0195 0.0197 0.0247 0.0197 0.0209 0.0202 0.0194 0.0192 0.0198 0.0198 0.0198 0.0198 0.0198 0.0198 0.0198 0.0198 0.0198 0.0198 0.01916 0.0916 0.0916 0.0916 0.0916	1.24 2.52 5.83 3.70 3.31 0.424 1.88 53.5 0.535 1.65 0.245 15.8 6.31 0.645 13.29 6.32 0.648 0.930 3.93 11.1 27.9 50 12.5 16.5 16.5 16.5 16.5 16.5 16.5 16.5 16	16 28 10 40 16 17 36 33 17 13 20 25 29 21 19 16 13 14 28 25 15 18 31 10 25 12 24 22 12 20 34 13 20 31 31 31 31 31 31 31 31 31 31 31 31 31	R184421-5 R184421-5	WG140662 WG140662
Bromodichloromethane Bromoform Bromomethane Carbon tetrachloride Chlorobenzene	mg/l mg/l mg/l mg/l mg/l mg/l	0.0204 0.0189 0.0205 0.0082 0.0175 0.0193	0.0207 0.0218 0.0220 0.0102 0.0180 0.0195	1.65 14.3 6.97 21.5 2.53 1.39	22 13 18 20 36 21	R184421-5 R184421-5 R184421-5 R184421-5 R184421-5 R184421-5	WG140662 WG140662 WG140662 WG140662



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R184421-5 WG140662

Est. 1970

MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

Chlorodibromomethane

Quality Assurance Report Level II

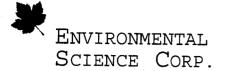
0.0186 0.0197 5.54 17

January 20, 2004

St. Louis, MO 63043	
	L141005

mg/1

CITTOTOGEDIOMOMOCHIGHIC	9/ -	0.0100	<del></del>				
Analyte	Laborato Units	ry Control LCSD Res		Duplicate RPD	Limit	Ref Samp	Batch
Chloroothano	m~ /1	0.0126	0.0133	6.10	25	- D104401 E	WG140662
Chloroethane	mg/1					R184421-5	
Chloroform	mg/l	0.0194	0.0191	1.35	26	R184421-5	WG140662
Chloromethane	mg/l	0.0097	0.0104	6.97	31	R184421-5	WG140662
cis-1,2-Dichloroethene	mg/l	0.0181	0.0185	2.24	18	R184421-5	
cis-1,3-Dichloropropene	mg/l	0.0203	0.0210	3.53	17	R184421-5	WG140662 /
Di-isopropyl ether	mg/l	0.0207	0.0207	0.386	13	R184421-5	WG140662
Dibromomethane	mg/l	0.0182	0.0217	17.5	12	R184421-5	WG140662
Dichlorodifluoromethane	mg/l	0.0053	0.0055	3.83	28	R184421-5	WG140662
Ethylbenzene	mg/1	0.0188	0.0187	0.160	25	R184421-5	WG140662
	mg/l						
Hexachlorobutadiene	mg/l	0.0165	0.0176	5.99	36	R184421-5	
Isopropylbenzene	mg/l	0.0169	0.0173	2.04	29	R184421-5	WG140662
Methyl tert-butyl ether	mg/l	0.0208	0.0218	4.84	16	R184421-5	WG140662
Methylene Chloride	mq/1	0.0187	0.0191	2.07	16	R184421-5	WG140662
n-Butylbenzene	mg/l	0.0187	0.0188	0.587	30	R184421-5	WG140662
n-Propylbenzene	mg/l	0.0190	0.0191	0.473	30	R184421-5	WG140662
Naphthalene	mg/1	0.0166	0.0183	9.67	39	R184421-5	WG140662
					36		
p-Isopropyltoluene	mg/l	0.0198	0.0196	0.916		R184421-5	WG140662
sec-Butylbenzene	mg/1	0.0184	0.0182	1.09	32	R184421-5	WG140662
Styrene	mg/l	0.0199	0.0198	0.151	21	R184421-5	WG140662
tert-Butylbenzene	mg/l	0.0200	0.0201	0.398	30	R184421-5	WG140662
Tetrachloroethene	mg/1	0.0188	0.0187	0.854	32	R184421-5	WG140662
Toluene	mg/l	0.0191	0.0194	1.87	17	R184421-5	WG140662
trans-1,2-Dichloroethene	mg/1	0.0176	0.0176	0.00	27	R184421-5	WG140662
trans-1,3-Dichloropropene	mg/l	0.0187	0.0198	5.62	16	R184421-5	WG140662
Trichloroethene	mg/l	0.0178	0.0181	1.72	25	R184421-5	WG140662
Trichlorofluoromethane	mg/1	0.0120	0.0125	4.65	41	R184421-5	WG140662
Vinyl chloride	mg/1	0.0109	0.0115	5.81	36	R184421-5	WG140662
Xylenes, Total	mg/l	0.0586	0.0574	2.05	21	R184421-5	WG140662
• • • • • • • • • • • • • • • • • • •	5/						
Iron, Dissolved	mg/l	1.21	1.19	1.67	20	R184440-3	WG140681
Manganese, Dissolved		1.20	1.20	0.00	20		WG140681
manganese, Dissolved	mg/l	1.20	1.20	0.00	20	R184440-3	MGT-4000T
Chil and de	/7	16.5	15 0	1 66	0.0	D104401 0	TYC1 40006
Chloride	mg/1	16.7	17.0	1.66	20	R184491-2	WG140706
Nitrite	mg/l	3.51	3.56	1.51	20	R184491-2	WG140706
							4
Sulfide	mg/l	0.500	0.530	5.83	20	WG140829-2	2 WG140829
			1.				
DOC	mq/1	3.90	4.60	16.5	20	WG140996-2	2 WG140996
		Matris	Spike				
Analyte	Units	MS Res	Ref Res	TV % F	ec Limit	Ref Samp	o Batch
12102 7 00		110 1100	HOI HOD		CC DIMI	, rei bang	<del>J Daton</del>
Nitrate	mg/1	4.74	0.0228	E 07	.4 80-12	00 T140643	-21 WG140525
	g/1						
Nitrite	mg/l	4.72	0.00		.5 80-12		-21 WG140525
Sulfate	mg/l	48.2	0.00	50 96	1.4 80-12	20 L140643-	-21 WG140525
TOC (Total Organic Carbon)	mg/l	20.0	0.00	20 100	0. 80-12	20 L140971	-01 WG140588
<del>-</del>	-						
Iron	mg/l	1.05	0.00	1.13 93	.0 75-12	25 L141005	-01 WG140610
	3/						4
1,1,1,2-Tetrachloroethane	mg/l	0.0210	0.00	0.02 105	67-13	39 T.14100E	-02 WG140662
1,1,1-Trichloroethane			0.00		.4 46-14		
	mg/l	0.0183					-02 WG140662
1,1,2,2-Tetrachloroethane	mg/l	0.0211	0.00	0.02 105			-02 WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane		0.0190	0.00		.8 30-13		-02 WG140662
1,1,2-Trichloroethane	mg/l	0.0174	0.00	0.02 87	0.0 70-12		-02 WG140662
1,1-Dichloroethane	mq/1	0.0203	0.00	0.02 102	47-13	38 L141005	-02 WG140662
1,1-Dichloroethene	mg/l	0.0218	0.00	0.02 109			-02 WG140662
1,1-Dichloropropene	mq/l	0.0187	0.00		.7 49-14		-02 WG140662
1,2,3-Trichlorobenzene	mq/1	0.0155	0.00		.4 63-12		-02 WG140662
T'S'S-ITTOHTOTODEHVEHE	"(A) T	0.0155	0.00	0.02 /	03-14	DIAIOOD.	02 NG140002



Tax I.D. 62-0814289

Est. 1970

MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

Quality Assurance Report

L141005

Level II

January 20, 2004

St. Louis, MO 63043

1,2,3-Trichloropropane	mg/l	0.0192	0.00	0.02	95.9 66-124	L141005-02	WG140662
Analyte	Units	Matri MS Res	x Spike				
	UIILLE	MS RES	Ref Res	TV	% Rec Limit	Ref Samp	Batch
1,2,3-Trimethylbenzene	mg/l	0.0163	0.00	0.02	81.7 51-109	L141005-02	WG140662
1,2,4-Trichlorobenzene 1,2,4-Trimethylbenzene	mg/l	0.0151	0.00	0.02	75.6 52-130	L141005-02	
1,2-Dibromo-3-Chloropropane	mg/l	0.0220	0.00	0.02	110. 62-126	L141005-02	WG140662
1,2-Dibromoethane	mg/l	0.0199	0.00	0.02	99.5 48-122	L141005-02	WG140662
1,2-Dichlorobenzene	mg/l	0.0206	0.00	0.02	103. 74-121	L141005-02	WG140662
1,2-Dichloroethane	mg/l mg/l	0.0164	0.00	0.02	82.0 65-119	L141005-02	WG140662
1,2-Dichloropropane	mg/1	0.0188	0.00	0.02	93.8 48-148	L141005-02	WG140662
1,3,5-Trimethylbenzene	mq/1	0.0193 0.0194	0.00 0.00	0.02	96.7 66-122	L141005-02	WG140662
1,3-Dichlorobenzene	mg/1	0.0186	0.00	0.02	96.8 60-127	L141005-02	WG140662
1,3-Dichloropropane	mq/l	0.0206	0.00	0.02	92.8 62-122 103. 77-121		WG140662
1,4-Dichlorobenzene	mg/l	0.0160	0.00	0.02	79.8 60-123	L141005-02	WG140662
2,2-Dichloropropane	mg/l	0.0193	0.00	0.02	96.4 40-148	L141005-02 L141005-02	WG140662
2-Butanone (MEK)	mg/l	0.107	0.00	0.1	107. 26-114	L141005-02	WC140662
2-Chloroethyl vinyl ether	mg/l	0.00	0.00	0.1	0.0 0-100	L141005-02	WG140662
2-Chlorotoluene	mg/1	0.0187	0.00	0.02	93.5 62-120	L141005-02	
4-Chlorotoluene	mg/1	0.0185	0.00	0.02	92.3 63-123	L141005-02	
4-Methyl-2-pentanone (MIBK) Acetone	mg/l	0.0871	0.00	0.1	87.1 56-133	L141005-02	WG140662
Acrolein	mg/l	0.0960	0.00	0.1	96.0 13-145	L141005-02	WG140662
Acrylonitrile	mg/l	0.221	0.00	0.1	221. 14-90	L141005-02	WG140662
Benzene	mg/l mg/l	0.107	0.00	0.1	107. 33-128	L141005-02	WG140662
Bromobenzene	mg/l	0.0215 0.0197	0.00	0.02	107. 55-130	L141005-02	WG140662
Bromodichloromethane	mq/1	0.0183	0.00	0.02	98.4 67-134	L141005-02	WG140662
Bromoform	mg/1	0.0214	0.00	0.02	91.5 57-126 107. 52-130	L141005-02	WG140662
Bromomethane	mg/l	0.0119	0.00	0.02	107. 52-130 59.5 17-150	L141005-02	WG140662
Carbon tetrachloride	mg/1	0.0187	0.00	0.02	93.7 42-141	L141005-02	WG140662
Chlorobenzene	mg/l	0.0195	0.00	0.02	97.7 66-125	L141005-02 L141005-02	WG140662
Chlorodibromomethane	mg/l	0.0193	0.00	0.02	96.4 58-123	L141005-02	WG140662
Chloroethane Chloroform	mg/l	0.0170	0.00	0.02	85.0 29-131	L141005-02	WG140662
Chloroform Chloromethane	mg/l	0.0191	0.00	0.02	95.5 46-136	L141005-02	WG140662
cis-1,2-Dichloroethene	mg/l	0.0173	0.00	0.02	86.4 26-120	L141005-02	WG140662
cis-1,3-Dichloropropene	mg/l	0.0230	0.0062		83.9 59-133	L141005-02	WG140662
Di-isopropyl ether	mg/1	0.0171	0.00	0.02	85.3 77-132	L141005-02	WG140662
Dibromomethane	mg/l mg/l	0.0233	0.00	0.02	117. 47-141	L141005-02	WG140662
Dichlorodifluoromethane	mg/l	0.0176 0.0133	0.00	0.02	87.9 64-119	L141005-02	WG140662
Ethylbenzene	mg/l	0.0198	0.00	0.02	66.4 13-113	L141005-02	WG140662
Hexachlorobutadiene	mg/1	0.0130	0.00	0.02 0.02	98.9 61-123 65.1 39-138	L141005-02	WG140662
Isopropylbenzene	mg/l	0.0172	0.00	0.02	85.8 56-120	L141005-02	WG140662
Methyl tert-butyl ether	mg/l	0.114	0.00	0.02	571. 43-140	L141005-02 L141005-02	WG140662
Methylene Chloride	mg/l	0.0205	0.00	0.02	103. 55-123	L141005-02	
n-Butylbenzene	mg/l	0.0153	0.00	0.02	76.4 43-139	L141005-02	WG140662
n-Propylbenzene Naphthalene	mg/l	0.0187	0.00	0.02	93.7 57-127	L141005-02	WG140662
p-Isopropyltoluene	mg/l	0.0205	0.00	0.02	102. 39-122	L141005-02	
sec-Butylbenzene	mg/l	0.0181	0.00	0.02	90.6 58-127	L141005-02	
Styrene	mg/l	0.0180	0.00	0.02	89.8 55-124	L141005-02	WG140662
tert-Butylbenzene	mg/l	0.0197	0.00	0.02	98.6 61-119	L141005-02	WG140662
Tetrachloroethene	mg/l mg/l	0.0193	0.00	0.02	96.5 58-129	L141005-02	WG140662
Toluene	mg/l	0.0194 0.0166	0.00 0.00	0.02	96.9 49-144	L141005-02	WG140662
trans-1,2-Dichloroethene	mg/l	0.0198	0.00	0.02	83.1 59-123	L141005-02	WG140662
trans-1,3-Dichloropropene	mg/1	0.0159	0.00	0.02	99.1 53-145	L141005-02	WG140662
Trichloroethene	mg/l	0.0184	0.00	0.02	79.4 69-125 91.8 61-141	L141005-02	WG140662
Trichlorofluoromethane	mg/1	0.0144	0.00	0.02	72.2 24-113	L141005-02 L141005-02	WG140662
Vinyl chloride	mg/l	0.0175	0.0018		78.4 26-110	L141005-02	MG140667
Xylenes, Total	mg/l	0.0650	0.00	0.06	108. 64-119	L141005-02	WG140662
Iron, Dissolved	, = ·						
11011, 113801 VEU	mg/l	11.9	11.0	1.13	82.3 75-125	L141005-02	WG140681



Tax I.D. 62-0814289

Est. 1970

MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

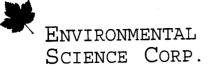
St. Louis, MO 63043

Quality Assurance Report Level II

L141005

January 20, 2004

Sc. Hours, No obors		L14100	5					
	mg/l	7.70	6.70	1.13	88.6	75-125	L141005-02	WG140681
Manganese,Dissolved	<u> </u>							
			x_Spike		n	T 2 2 E	Ref Samp	Batch
Analyte	Units	MS Res	Ref Res	TV	* Rec	Limit	Ker Samp	Baccii
	mq/l	0.960	0.00	1	96.0	80-120	L141005-01	WG140829
Sulfide	mg/ ±	0.500	0.00					
DOC	mg/l	20.0	2.60	20	87.0	80-120	L141005-01	WG140996
Boc								
	N	Matrix Spi	ke Dupilc	ace RPD	T.im	it %Rec_	Ref Samp	Batch
Analyte	Units	MSD Res	Rei Res	RPD	111111	IL SICC		
Nitrate	mg/1	4.76	4.74	0.271	20	94.7	L140643-23	L WG140525
Nitrite	mg/1	4.75	4.72	0.544		95.0	L140643-23	
Sulfate	mg/l	48.3	48.2	0.151	20	96.6	L140643-2.	1 WG140525
	/-	00.0	20.0	0.00	20	100.	T.140971-0	1 WG140588
TOC (Total Organic Carbon)	mg/1	20.0	20.0	0.00	20	100.	H1105/1 0.	
<b>→</b>	mg/l	1.09	1.05	3.37	20	96.2	L141005-0	1 WG140610
Iron	1119/ 1	2.03						
1,1,1,2-Tetrachloroethane	mg/l	0.0189	0.0210	10.3	16	94.5		2 WG140662
1,1,1-Trichloroethane	mg/l	0.0184	0.0183	0.546		91.9		2 WG140662
1.1.2.2-Tetrachloroethane	mg/1	0.0180	0.0211	15.7	10	90.1	L141005-0	2 WG140662 2 WG140662
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/1	0.0180	0.0190	5.19	40	90.0	L141005-0	2 WG140002
1,1,2-Trichloroethane	mg/l	0.0170	0.0174	2.21	16	85.1		2 WG140662
1.1-Dichloroethane	mg/l	0.0193	0.0203	5.30	17	96.4		2 WG14066
1,1-Dichloroethene	mg/1	0.0202	0.0218	7.52	36	101.	L141005-0	2 WG140662
1,1-Dichloropropene	mg/l	0.0178	0.0187	4.87	33	89.2		2 WG140662 2 WG140662
1,2,3-Trichlorobenzene	mg/1	0.0168	0.0155	8.00	17	83.8		2 WG140662 2 WG140662
1,2,3-Trichloropropane	mg/1	0.0170	0.0192	12.0	13	85.1	1141005-0	2 WG140662 2 WG140662
1,2,3-Trimethylbenzene	mg/l	0.0163	0.0163	0.245		81.5		2 WG140662
1,2,4-Trichlorobenzene	mg/1	0.0158	0.0151	4.15	25	78.8		2 WG140662
1,2,4-Trimethylbenzene	mg/1	0.0200	0.0220	9.58	29	99.9		2 WG140662
1,2-Dibromo-3-Chloropropane	mg/l	0.0171	0.0199	14.9	21	85.7	T141005-0	2 WG140662
1,2-Dibromoethane	mg/l	0.0179	0.0206	14.3	19	89.3	1141005-0	2 WG140662
1,2-Dichlorobenzene	mg/1	0.0164	0.0164	0.122		82.1	1141005-0	2 WG140662
1,2-Dichloroethane	mg/l	0.0183	0.0188	2.70	13	91.3 95.5		2 WG140662
1,2-Dichloropropane	mg/1	0.0191	0.0193	1.25	14			2 WG140662
1,3,5-Trimethylbenzene	mg/1	0.0180	0.0194	7.23	28	90.1 86.3		2 WG140662
1,3-Dichlorobenzene	mg/l	0.0173	0.0186	7.20	25 15	89.3		2 WG140662
1,3-Dichloropropane	mg/1	0.0179	0.0206	14.4	18	81.8		2 WG140662
1,4-Dichlorobenzene	mg/l	0.0164	0.0160	$2.41 \\ 2.31$	31	94.2	T.141005-0	2 WG140662
2,2-Dichloropropane	mg/l	0.0188	0.0193 0.107	13.2	10	93.4	T-141005-0	2 WG140662
2-Butanone (MEK)	mg/l	0.0934	0.107	0.00	25	0.00		2 WG140662
2-Chloroethyl vinyl ether	mg/l	0.00 0.0170	0.0187	9.41	24	85.1	L141005-0	2 WG140662
2-Chlorotoluene	mg/1	0.0167	0.0185	9.83	22	83.7	L141005-0	2 WG140662
4-Chlorotoluene	mg/l mg/l	0.0942	0.0871	7.79	12	94.2		2 WG140662
4-Methyl-2-pentanone (MIBK)	mg/1	0.0826	0.0960	15.0	23	82.6	L141005-0	2 WG140662
Acetone	mg/1	0.175	0.221	23.6	34	175.	L141005-0	)2 WG140662 <del>-</del>
Acrolein	mq/1	0.0930	0.107	13.8	13	93.0		)2 WG140662
Acrylonitrile	mg/1	0.0203	0.0215	5.41	20	102.	L141005-0	2 WG140667
Benzene	mg/1	0.0183	0.0197	7.05	22	91.7	L141005-0	2 WG140662
Bromobenzene Bromodichloromethane	mg/1	0.0181			13	90.6	L141005-0	2 WG140662
Bromoform	mg/l	0.0191			18	95.5	L141005-(	02 WG140662
Bromomethane	mg/l	0.0101		15.9	20	50.7	L141005-0	02 WG140662
Carbon tetrachloride	mq/l	0.0185	0.0187	1.40	36	92.4		02 WG140663
Chlorobenzene	mg/l	0.0176	0.0195	10.5	21	88.0	L141005-0	02 WG140662
Chlorodibromomethane	mg/l	0.0169			17	84.6	L141005-	02 WG140662
Chloroethane	mg/l	0.0152			25	76.2	L141005-0	02 WG140662
Chloroform	mg/l	0.0185				92.3	L141005-0	02 WG14066
Chloromethane	mg/l	0.0153		_	31	76.3		02 WG140662
cis-1,2-Dichloroethene	mg/l	0.0205	0.0230		18	71.3	5 L141005-0	02 WG140662
cis-1,3-Dichloropropene	mg/1	0.0194	0.0171	12.8	17	97.0	) L141005-0	02 WG140662
<u> </u>	_							4



Tax I.D. 62-0814289

Est. 1970

MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

St. Louis, MO 63043

Quality Assurance Report

Level II L141005

January 20, 2004

0.0216 0.0233 7.65 13 108. L141005-02 WG140662 mg/lDi-isopropyl ether 

		Matrix Spi	ke Duplica	ate				D - h - h
Analyte	Units	MSD Res	Ref Res	RPD	Limit	%Rec_	Ref Samp	Batch
Dibromomethane Dichlorodifluoromethane Ethylbenzene Hexachlorobutadiene Isopropylbenzene Methyl tert-butyl ether Methylene Chloride n-Butylbenzene n-Propylbenzene Naphthalene p-Isopropyltoluene sec-Butylbenzene Styrene tert-Butylbenzene Tetrachloroethene Toluene trans-1,2-Dichloroethene trans-1,3-Dichloropropene Trichloroethene Trichloroethene Trichlorofluoromethane Vinyl chloride Xylenes, Total	mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg/l	0.0186 0.0129 0.0175 0.0141 0.0158 0.102 0.0194 0.0155 0.0165 0.0171 0.0165 0.0177 0.0181 0.0177 0.0180 0.0180 0.0180 0.0180	0.0176 0.0133 0.0198 0.0130 0.0172 0.114 0.0205 0.0153 0.0187 0.0205 0.0181 0.0180 0.0197 0.0193 0.0194 0.0166 0.0198 0.0159 0.0159 0.0159 0.0184 0.0144 0.0175 0.0650	5.85 3.29 12.2 7.90 8.51 11.5 5.55 1.24 10.3 3.17 6.08 8.29 12.0 6.37 9.01 13.4 5.98 12.8 1.43 3.02 8.90 11.1	12 28 25 36 29 16 30 39 36 32 21 30 32 17 27 16 25 41 36 21	93.2 64.3 87.5 70.4 78.8 509.2 77.4 85.3 82.7 87.5 895.3 90.5 70.1 96.9	L141005-02 L141005-02	WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662 WG140662
Iron,Dissolved Manganese,Dissolved	mg/l mg/l	11.9 7.69	11.9 7.70	0.513 0.143	20	76.9 87.6	L141005-02 L141005-02	WG140681
Sulfide	mg/l	0.990	0.960	3.08	20	99.0	L141005-0	
DOC	${ m mg}/1$	20.0	20.0	0.00	20	87.0	L141005-01	l WG140996

Batch number /Run number / Sample number cross reference

WG140657: R184316: L141005-01 02 03 WG140657: R184316: L141005-01 02 03 WG140619: R184323: L141005-01 02 03 WG140610: R184336: L141005-01 02 03 WG140588: R184349: L141005-01 02 03 WG140525: R184382: L141005-01 02 03 WG140662: R184421: L141005-01 02 03 WG140681: R184440: L141005-01 02 03 WG140829: R184444: L141005-01 02 03 WG140706: R184491: L141005-01 02 03 WG140996: R184578: L141005-01 02 03

<sup>\*</sup> See Attachment B of standard report for list of qualifiers. \* Calculations are performed prior to rounding of reported values .



Tax I.D. 62-0814289

Est. 1970

MACTEC - St. Louis, MO Mr. Dennis Brinkley 3199 Riverport Tech Center Drive

St. Louis, MO 63043

Quality Assurance Report Level II

L141005

January 20, 2004

### ESC Level 2 Data Package

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of regent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.